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Ashfordia granulata (Alder) on Achill Island.—In May, 1937, I found this species in plenty on a low wet sea cliff of glacial drift at Keil, Achill (West Mayo), where it was associated with *Pupa cylindracea*, *Lymnæa truncatula* and *Succinea pfeifferi*. It is apparently a rare snail in Connaught, but the Society's census includes a record for Sligo and Mr. A. W. Stelfox tells me that in 1922 he detected a half-grown example, now in his collection, in a sample of flood rubbish collected in 1907 at Claremorris (East Mayo) by R. J. Welch.—CHAS. OLDHAM. (*Read before the Society, 4th September, 1937.*)

AN APPARENTLY UNDESCRIBED SPECIES OF POTADOMA SWAINSON.

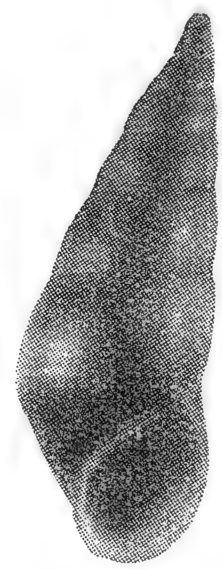
By M. Connolly.

(Read before the Society, 9th October, 1937.)

Among a small collection of non-marine mollusca recently received by B. Sundler from the French Congo, the following species appears to be new to science; Mr. Sundler has kindly presented the type to the British Museum.

Potadoma tigrinum sp.n.

Shell of fair size, elongate turriform, imperforate, solid, rather dull and silky. Later whorls tawny buff, with a broad peripheral dark brown band, which is visible above the suture of some of the earlier whorls. Spire produced, with straight sides, apex acute. Whorls ten, regularly increasing, nearly flat, first four or five practically smooth, remainder covered with extremely fine and close, minutely rippling or granulate spiral striolæ, with about five fine, slightly distant cords around the base; within the dark band, just below the periphery, is a well defined flat spiral groove, broad enough to contain five of the spiral striolæ, and becoming weaker near the aperture of mature shells; suture simple, shallow. Aperture acuminate ovate, narrowly rounded at base, peristome simple, columellar region and callus white and glossy, operculum thin, corneous, paucispiral.



Long., 35·5; lat., 13·8; apert. alt., 12·0, lat., 8·2; last whorl, 19 mm.

Hab.: French Congo, Indo Sibiti (Rev. A. Unsgaard).

The sculpture of the new species much resembles that of *P. graptoconus* Pilsb. & Beq., but the shell is usually rather more slender, while the tiger-like banding and flat infraperipheral groove are absent from *graptoconus*. This groove seems to be present in *P. schoutedeni* P. & B., but in other respects the new species appears to be so amply distinct from that and all others of the genus which I have been able to trace, as to merit full specific rank.

SOME ZOOGEOGRAPHICAL CORRECTIONS.

By Holger Madsen.

(*Read before the Society, 13th February, 1937.*)

During my work upon the Arctic shore fauna (Holger Madsen, 1936) I discovered some zoogeographical errors circulating in literature. They concern the following species: Lamellibranchs, *Cyprina islandica* (L.), *Macoma balthica* L., *Mya arenaria* L. and the Prosobranch *Skeneopsis planorbis* (O. Fabricius).

Thiele, 1928, p. 622, records *Cyprina islandica* from Greenland. Already in 1902 Ad. S. Jensen has shown that the species does *not* occur there.

Macoma balthica, according to Jensen, 1905, p. 27, is distributed along the west coast of Greenland to 72° W. lat. In the same paper it is shown that it is not found in Iceland, the Faeroes, Jan Mayen, Spitzbergen, the Kara Sea, and the north coast of Siberia (a doubtful find in Novaja Zemlja being mentioned); in the Pacific the northern limit is at Port Clarence. So the species can by no means be called circumpolar, Thiele, 1928, p. 623, doing so.

Likewise Thiele (loc. cit., p. 625) says that *Mya arenaria* is distributed to Greenland, Spitzbergen, and Novaja Zemlja. But also here Jensen (1900, pp. 142 sqq., 147) has proved that it is *not* found in Greenland, Iceland, the Faeroes, Spitzbergen, the Kara Sea, and the Siberian Arctic Sea, either living or fossil, all specimens supposed to be *Mya arenaria* proving to be *Mya truncata*.

Finally some remarks should be made upon *Skeneopsis planorbis*. In Greenland this species is living along the west coast at any rate to Godhavn, where it has been caught in 5 fms. According to Posselt (1898, p. 221): "It is found almost everywhere, though not very abundantly, in the tidal zone under stones and amongst species of Fucus [manuscript of Møller]. This hardly holds good for the whole west coast." Fabricius (1780, p. 394, No. 393) writes that "it is commonly living on clayey sand shores under stones".

Where the distribution of this species is mentioned in literature it is said to live in Spitzbergen (so Thiele, 1928, p. 586). This statement could be traced to Torell, 1859, as the only source. Via Jeffreys (*British Conchology*, vol. iv, p. 66, 1865), according to kind information by Dr. N. Odhner, the statement has travelled into literature.

Let us now consult Torell himself. On p. 34 he distinctly states that he has *not* found the species in Spitzbergen! Dr. Odhner

informs me that the species is not found in the extensive collections from Spitzbergen of the Museum of Stockholm either, so the species is to be eliminated from the fauna of Spitzbergen.

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Ancylus fluviatilis in Aquaria.—In December, 1934, several specimens (about 10–20) of the above were obtained from a stream in Cromwell Wood, Southowram, near Halifax, Yorkshire, and placed in an aquarium. The dimensions of the aquarium were 30 by 12 by 12 inches, with mud 2 inches deep in the bottom and 8–10 inches of water above it. The water in the aquarium was not changed but tap water was added to make up losses due to evaporation. Plants growing in the aquarium were *Lemna*, *Elodea*, *Sagittaria*, and *Alisma*. I thought at the time that all the molluscs died, but in March, 1935, was pleased to see one very fine specimen adhering to the glass side. I could not find any further examples and so concluded that this was the sole survivor of the batch introduced. Then, on 26th June, 1935, I noticed several young ones on side of aquarium. On 18th July, 1935, there were fifty-six young ones, in four separate sizes, and the large one was still present. The fifty-six young dwindled in numbers until in December, 1936, nine were found in the aquarium, all roughly of the same size and apparently healthy; the adult had disappeared. ERNEST DEARING. (*Read before the Society, 13th February*, 1937.)

Marine Shells at Whitepark Bay, Co. Antrim.—The following were picked up in a few minutes in May, 1936, from a large shell-heap washed up in winter storms, 1935–6, at the east end of Whitepark Bay, Co. Antrim, Northern Ireland: *Patella vulgata* L., common; *Patina pellucida* (L.), common; *Calliostoma zizyphinum conuloide* (Lam.), six; *Gibbula cineraria* (L.), nine; *Lacuna vincta* (Mont.), one; *Littorina littorea* (L.), common; *Littorina littoralis* (L.), common; *Trivia monacha* (da Costa), four; *Nucella lapillus* (L.), common; *Ocenebra erinacea* (L.), two; *Mytilus edulis* L., valves; and *Cardium edule* L.—J. WILFRID JACKSON.

NOTES ON NORTHERN MOLLUSCA. I.

By HANS SCHLESCH.

(Read before the Society, 13th February, 1937.)

1. TRICHIA (TRICHIA) HISPIDA TUMESCENS Westl.

WESTERLUND (1881) described *Helix tumescens* without anatomical examination from Stockholm (Sirishof), and later on it was recorded by the same author (1897, p. 50) from several places in the vicinity of Stockholm (Carlberg, Djurgården, Valdemarsudde, Drottningholm, Stäcket), Uppsala (Botanic Garden), and Gefle, and by Sundler (1923, p. 11) from Fristad, near Borås, in Västergötland.

When, on 25–6–1936, in fellowship with Professor Dr. Th. Schmierer, I collected on the S.W. Omberg at the Lake Vättern, we found a good number of this form; moreover, through the kindness of Dr. Gösta Jägersten, I received it from Uppsala Botanic Garden and from Mr. F. A. Svalander from the neighbourhood of Eksjö in North Småland. Dr. Nils Odhner kindly lent me for comparison type specimens from Riksmuseet in Stockholm. An anatomical examination of the genital organs, confirmed by Dr. H. Wagner (Buda-Pest) and Mr. Hugh Watson showed that in *Helix tumescens* they are of the same type as that found in *Trichia hispida* L. and its near allies, and possess four dart-sacs, whereas in *Zenobiella rubiginosa* A. Schm. there is only one dart-sac and the genital organs are quite distinct. *Trichia hispida tumescens* Westl. seems to be widely distributed in the middle of Sweden.

2. ZENOBIELLA (ZENOBIELLA) RUBIGINOSA A. Schm.

The first record from Scandinavia was given by Westerlund (1871–3, p. 141) from a small brook at Kohlstad above Borgholm, Isle of Öland, collected 30–6–1870; there is also a single specimen from the Isle of Gotland in the Museum of Visby (Westerlund, 1897, p. 50). The value of this record was, however, rather doubtful, since the specimens were not anatomically examined (Schlesch, 1936, p. 234), but when I visited the Isle of Öland in June–July, 1936, together with Professor Schmierer and Mr. Svalander, we found *Zenobiella rubiginosa* A. Schm. not only at the above locality at Kohlstad, but the species seems to be distributed through the entire isle. It is, however, hitherto not found on the mainland of Scandinavia.

3. HELICELLA (CANDIDULA) CANDIDULA Stud.

This species was in Sweden first discovered by Dr. Rich. Hägg in 1929, in the lime quarry of Hanaskog, *c.* 14 km. north of Kristianstad, N.E. Scania, and recorded by John Bernström (1935, pp. 264–8), but previously from Denmark (Schlesch, 1934, p. 43), found at

Kongsbjerg, Mandemark, Isle of Möen, 2–7–1933. Bernström (loc. cit., p. 268) is of the opinion that this southern species possibly has been introduced by birds, since the centre of the extension lies in the lime quarry, and fields in culture are not found in the near neighbourhood.

As I examined this locality with Professor Schmierer, 7–7–1936, we cannot agree fully with Bernström, since we found *Medicago*, two species, and *Esparsette* in good numbers, that it has not occasionally immigrated from a neighbouring field.

4. Ena (Ena) montana Drap.

For the first time this species was observed in North Europe by O. A. Andersson in 1864, on the steep slopes of Vättern at Rosenlund, in the neighbourhood east of Jönköping, and later found on the Southern Omberg at Vättern by K. Ahlner (Westerlund, 1971–3, pp. 169–170). I examined together with Professor Schmierer and Mr. Svalander the locality at Rosenlund and we found that *Ena montana* Drap. still is well distributed there, but unfortunately it seems to be extinct on Omberg.

5. Vertigo (Vertigo) lilljeborgi Westl.

The type locality is the southern shore of Lake Tresjön, near Ronneby, in Blekinge, S.E. Sweden, found by Westerlund, 23–8–1865, first named as *Vertigo modesta* (Westerlund, 1865, p. 556), but since this name was already preoccupied for another species by Say (1824, p. 259) Westerlund re-named it in honour of Professor W. Lilljeborg, first in a list forwarded for exchange in 1868, and later in 1871 (p. 90). When Professor Schmierer and I came to Ronneby, 6–7–1936, we had some trouble to find the locality; nobody had any knowledge of the existence of a lake named Tresjön; it was not to be found on the maps and there are numerous small lakes in the neighbourhood, but we were lucky enough to find a former pupil of Westerlund who could tell us that Tresjön was situated at Hulta, east of Ronneby. It is, however, now overgrown and only forms a meadow; so the type locality seems to be destroyed.

6. Vertigo pineticola Westl. and Vertigo ovoidea Westl.

Westerlund (1871, pp. 96–7) described these two species (together with *Pupa otostoma*, p. 100 = *Vert. pusilla* Müll. ?) as found by E. Hemberg 1867–8 on wooded mountainous slopes at the road to Augustenborg above the Lake Tenhult in N.W. Småland, south of Jönköping. This locality forms now only a part of a private park and is partly cultivated. When Professor Schmierer, Mr. Svalander and I, on 24–6–1936, examined the place we found after hard work besides *Vertigo pusilla* Müll. and a single *Vert.*

alpestris Ald. with three teeth, only three specimens of *Vertigo arctica* Wallb.; these possibly may be found identical with Westerlund's "species".

7. Pupilla (Pupilla) muscorum Müll.

The type locality for *Turbo muscorum* of Linnæus is Triberga borg, in S.E. Öland (Linné, 1745, p. 99), collected during his visit in 1741. As already several authors point out, there have been different opinions regarding the identity of this species, since the description does not agree with that of *Pupilla muscorum* Müll. Without doubt *Turbo muscorum* L. includes more than one species (Westerlund, 1871–3, p. 245). During a careful examination of Triberga borg with Mr. Svalander, 3–7–1936, I can confirm that on the stones exposed to the sun are only found *Chondrina clienta* (Westl.) Ehrm.; under the stones between grass roots we, however, took a few *Pupilla muscorum* Müll., which agree with that figured by Hanley (1855, p. 352, pl. 4, fig. 6).

8. Viviparus (Viviparus) viviparus L. in Sweden.

Westerlund (1897, p. 132) gives the distribution between the mouth of Dalelf (60° 30′ N. lat.) and Västervik (*c.* 57° 45′ N. lat.). The species occurs, however, very abundantly in the lakes and rivers belonging to the River Emå in the neighbourhood of Eksjö in North Småland; as Emå goes out into the Baltic between Oskarshamn and Mönsterås in the south (*c.* 57° N. lat.), possibly other localities will be found as soon as this district is carefully examined. In Ljungbyå, near Hossmo Church, south of Kalmar, I found *Viviparus lacustris* Beck (= *V. viviparus* Müll. pars) still living, already mentioned previously by Westerlund (1865, p. 543).

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THE NOMENCLATURE OF BRITISH NUDIBRANCH MOLLUSCA BY ALDER AND HANCOCK AND BY ELIOT CORRELATED WITH THAT OF BRITISH MARINE MOLLUSCA BY WINCKWORTH.

By Kathleen M. White, M.Sc., Zoology Department, University of Reading.

(*Read before the Society, 4th December*, 1937.)

It is considered that students of the British fauna would find it useful to have a list giving the names of species as found in Alder and Hancock's volumes and in Sir Charles Eliot's Supplement opposed to those in R. Winckworth's British Marine Mollusca, published in this *Journal*, vol. 19, pp. 211–252 (1932). This list is also published in pamphlet form by the Society. The following list gives, therefore, first the name occurring in British Nudibranch Mollusca and second the one in British Marine Mollusca, followed by its number in that publication.

Acknowledgments are due to Mr. Winckworth who has been consulted in regard to this list; he wishes me to state "clearly and emphatically" that the whole credit for disentangling the difficult synonymy of British nudibranchs is due to the work of Iredale and O'Donoghue; the result of their researches is published in the *Proceedings of the Malacological Society*, vol. 15, pp. 195–233 (1923). He further tells me that apart from the revival of *Tritonia* for their *Sphærostoma* (see this *Journal*, vol. 19, p. 33) the substitution of *Limacia* Müller for *Euphurus* Raf. (see *Proc. Malac. Soc.*, vol. 21, p. 323), and a ew minor alterations, his names do not differ from theirs.

Parts I to VII by Alder and Hancock.

Ægirus punctilucens (d'Orb.).	*Ægires punctilucens* 281.
Alderia modesta (Lov.).	Unchanged 270.
Ancula cristata (Ald.).	,, 308.
Antiopa cristata (Delle Chiaje).	*Janolus cristatus* 323.
A. hyalina A. & H.	*J. hyalinus* 324.
Dendronotus arborescens (Müll.).	*D. frondosus* 320.
Doris aspera A. & H.	*Onchidoris muricata* 295.
D. bilamellata Linn.	*O. fusca* 294.
D. coccinea For.	*Rostanga rufescens* 310.
D. depressa A. & H.	*Onchidoris depressa* 297.
D. diaphana A. & H.	*O. muricata* 295.
D. flammea A. & H.	*Archidoris flammea* 313.
D. inconspicua A. & H.	*Onchidoris inconspicua* 298.
D. Johnstoni A. & H.	*Jorunna tomentosa* 317.

D. millegrana A. & H.	*Aporodoris millegrana* 318.
D. oblonga A. & H.	*Onchidoris oblonga* 299.
D. pilosa Müll.	*Acanthodoris pilosa* 290.
D. planata A. & H.	*Geitodoris planata* 316.
D. proxima A. & H.	*Adalaria proxima* 292.
D. pusilla A. & H.	*Onchidoris* (*Atalodoris*) *pusilla* 300.
D. repanda A. & H.	*Cadlina lævis* 309.
D. sparsa A. & H.	*Onchidoris sparsa* 296.
D. subquadrata A. & H.	*Acanthodoris subquadrata* 291.
D. tuberculata Cuv.	*Archidori britannica* 312.
D. ulidiana Thomp.	*Onchidoris muricata* 295.
D. zetlandica A. & H.	*Aldisa zetlandica* 311.
Doto coronata (Gmelin).	*Idulia coronata* 330.
D. fragilis (For.).	*I. fragilis* 331.
D. pinnatifida (Mont.).	*I. pinnatifida* 332.
Embletonia minuta (For. & Goods.).	Unchanged 345.
E. pallida A. & H.	,, 347.
E. pulchra (A. & H.).	,, 346.
Eolis alba A. & H.	*Favorinus branchialis* 364.
E. Alderi Cocks.	var. of *Eolidina glauca* 371.
E. angulata A. & H.	Ditto.
E. amethystina A. & H.	*Eubranchus tricolor* 339.
E. amœna A. & H.	*Cuthona amœna* 352.
E. arenicola For.	col. var. of *Cratena viridis* 359.
E. aurantiaca A. & H.	*Cratena aurantia* 357.
E. cærulea (Mont.).	*Cratena cærulea* 356.
E. carnea A. & H.	*Favorinus carneus* 365.
E. cingulata (A. & H.).	*Eubranchus cingulatus* 342.
E. concinna A. & H.	*Cuthona concinna* 351.
E. coronata For.	*Facelina longicornis* 367.
E. couchii Cocks.	*Cuthona couchii* 354.
E. despecta (Johnst.).	*Tergipes despectus* 348.
E. Drummondi Thomp.	*Facelina drummondi* 366.
E. elegans A. & H.	*Facelina elegans* 369.
E. exigua A. & H.	*Eubranchus exiguus* 340.
E. Farrani A. & H.	var. of *Eubranchus tricolor* 339.
E. glauca A. & H.	*Eolidina glauca* 371.
E. glaucoides A. & H.	*Calma glaucoides* 363.
E. glottensis A. & H.	*Cratena glotensis* 360.
E. gracilis A. & H.	var. of *Coryphella verrucosa pellucida* 335*b*.
E. inornata A. & H.	*Eolidina inornata* 372.

E. Landsburgi A. & H.	*Coryphella pedata* 336.
E. lineata Lov.	*C. lineata* 338.
E. nana A. & H.	*Cuthona nana* 349.
E. northumbrica A. & H.	*Diaphoreolis northumbrica* 355.
E. olivacea A. & H.	*Cratena foliata* 358.
E. papillosa (Linn.).	*Æolidia papillosa* 370.
E. peachii A. & H.	*Cuthona peachii* 350.
E. pellucida A. & H.	*Coryphella verrucosa pellucida* 335*b*.
E. picta A. & H.	*Eubranchus tricolor pallidus* 339*b*.
E. punctata A. & H.	*Facelina punctata* 368.
E. purpurascens (Flem.).	not recognized since.
E. pustulata A. & H.	*Cuthona pustulata* 353.
E. rufibranchialis Johnst.	*Coryphella verrucosa rufibranchialis* 335*a*.
E. smaragdina A. & H.	*Eolidina glauca* 371.
E. stipata A. & H.	*Cratena stipata* 361.
E. tricolor (For.).	*Eubranchus tricolor* 339.
E. viridis (For.).	*Cratena viridis* 359.
E. vittata A. & H.	*Eubranchus vittatus* 341.
Eumenis marmorata A. & H.	*Lomanotus marmoratus* 327.
Fiona nobilis A. & H.	*Fiona pinnata* 362.
Goniodoris castanea A. & H.	Unchanged 303.
G. nodosa (Mont.).	,, 302.
Hermæa bifida (Mont.).	,, 267.
H. dendritica (A. & H.).	,, 268.
Idalia aspersa A. & H.	*Okenia* (*Idaliella*) *aspersa* 306.
I. elegans Leuck.	*Okenia elegans* 304.
I. leachii A. & H.	*Okenia leachii* 305.
Lomanotus flavidus (A. & H.).	Unchanged 328.
L. marmoratus A. & H.	,, 327.
Polycera lessonii d'Orb.	*Palio dubia* 287.
P. ocellata A. & H.	*P. nothus* 288.
P. quadrilineata (Müll.).	Unchanged 289.
Proctonotus mucroniferus (A. & H.).	*Zephyrina mucronifera* 322.
Scyllæa pelagica Linn.	Unchanged 321.
Thecacera capitata A. & H.	,, 286.
T. pennigera (Mont.).	,, 284.
T. virescens A. & H.	,, 285.
Triopa claviger (Müll.).	*Limacia clavigera* 282.
Tritonia alba A. & H.	*Tritonia* (*Candellista*) *alba* 278.
T. hombergii Cuv.	*Tritonia hombergii* 277.
T. lineata A. & H.	*T.* (*Duvaucelia*) *lineata* 280.
T. plebeia Johnst.	*T.* (*Duvaucelia*) *plebeia* 279.

Part VIII by Sir Charles Eliot.

Acanthodoris pilosa (Müll.).	Unchanged 290.
A. subquadrata (A. & H.).	,, 291.
Acteonia corrugata A. & H.	*Acteonia cocksii* 272.
Adalaria loveni (A. & H.).	Unchanged 293.
A. proxima (A. & H.).	,, 292.
Ægires punctilucens (d'Orb.).	,, 281.
Æolidia papillosa (Linn.).	,, 370.
Æolidiella alderi (Cocks).	var. of *Eolidina glauca* 371.
A. angulata (A. & H.).	Ditto.
A. glauca (A. & H.).	*Eolidina glauca* 371.
Alderia modesta (Lov.).	Unchanged 270.
Aldisa zetlandica (A. & H.).	,, 311.
Amphorina aurantiaca A. & H.	*Cratena aurantia* 357.
A. cærulea (Mont.).	*Cratena cærulea* 356.
A. glottensis (A. & H.).	*Cratena glotensis* 360.
A. olivacea (A. & H.).	*Cratena foliata* 358.
A. viridis (Forbes).	*Cratena viridis* 359.
Ancula cristata (Alder).	Unchanged 308.
Antiopella cristata (Delle Chiaje).	*Janolus cristatus* 323.
Aporodoris millegrana (A. & H.).	Unchanged 318.
Archidoris flammea (A. & H.).	,, 313.
A. testudinaria (Risso).	*A. stellifera* 314.
A. tuberculata (Cuv.).	*A. britannica* 312.
Cadlina repanda (A. & H.).	*Cadlina lævis* 309.
Calma glaucoides (A. & H.).	Unchanged 363.
Cenia cocksii (A. & H.).	*Acteonia cocksii* 272.
Coryphella gracilis (A. & H.).	var. of *Coryphella verrucosa pellucida* 335*b*.
C. landsburgii (A. & H.).	*Coryphella pedata* 336.
C. lineata (Lovén).	Unchanged 338.
C. pellucida (A. & H.).	*Coryphella verrucosa pellucida* 335*b*.
C. rufibranchialis (Johnst.).	*Coryphella verrucosa rufibranchialis* 335*a*.
C. salmonacea (Couth.).	Unchanged 337.
C. smaragdina (A. & H.).	var. of *Coryphella verrucosa pellucida* 335*b*.
C. verrucosa (M. Sars).	Unchanged 335.
Crimora papillata A. & H.	,, 283.
Cumanotus beaumonti (Eliot).	,, 343.
C. laticeps Odhner.	*Cumanotus beaumonti* 343.
Cuthona amœna (A. & H.).	Unchanged 352.

C. concinna (A. & H.).	Unchanged 351.
C. inornata (A. & H.).	*Eolidina inornata* 372.
C. nana (A. & H.).	Unchanged 349.
C. northumbrica (A. & H.).	*Diaphoreolis northumbrica* 355.
C. peachii (A. & H.).	Unchanged 350.
C. pustulata (A. & H.).	,, 353.
C. stipata (A. & H.).	*Cratena stipata* 361.
Dendronotus frondosus (Ascanius).	Unchanged 320.
D. lacteus (Thomp.)	probably var. of above.
Doris flammea A. & H.	*Archidoris flammea* 313.
D. maculata Garstang.	*Doridigitata sticta* (see *J. Conch.*, 20, p. 10).
D. testudinaria A. & H.	*Archidoris stellifera* 314.
D. tuberculata Cuv.	*A. britannica* 312.
D. verrucosa Cuv.	*Doridigitata derelicta* 315.
Doto cinerea Trinchese.	*Idulia cinerea* 334.
D. coronata (Gmelin).	*Idulia coronata* 330.
D. cuspidata A. & H.	*Idulia cuspidata* 333.
D. fragilis (For.).	*Idulia fragilis* 331.
D. pinnatifida (Mont.).	*I. pinnatifida* 332.
Elysia viridis (Mont.).	Unchanged 271.
Embletonia minuta (For. & Goods.).	,, 345.
E. pallida (A. & H.).	,, 347.
E. pulchra (A. & H.).	,, 346.
Facelina coronata (For.).	*Facelina longicornis* 367.
F. drummondi (Thomp.).	Unchanged 366.
F. punctata (A. & H.).	,, 368.
Favorinus albus (A. & H.).	*Favorinus branchialis* 364.
F. carneus (A. & H.).	Unchanged 365.
Fiona marina (Forskal).	*Fiona pinnata* 362.
Galvina amethystina (A. & H.).	*Eubranchus tricolor* 339.
G. clngulata (A. & H.).	*Eubranchus cingulatus* 342.
G. exigua (A. & H.).	*Eubranchus exiguus* 340.
G. farrani (A. & H.).	var. of *Eubranchus tricolor* 339.
G. vittata (A. & H.).	*Eubranchus vittatus* 341.
Geitodoris planata (A. & H.).	Unchanged 316.
Goniodoris castanea A. & H.	,, 303.
G. nodosa (Mont.).	,, 302.
Hancockia eudactylota Gosse.	,, 329.
Hermæa bifida (Mont.)	,, 267.
H. dendritica (A. & H.).	,, 268.
Hero formosa (Lov.).	,, 344.
Idalia elegans Leuck.	*Okenia elegans* 304.
I. leachii A. & H.	*Okenia leachii* 305.

Idaliella aspersa (A. & H.).	*Okenia* (*Idaliella*) *aspersa* 306.
I. pulchella (A. & H.).	*Okenia* (*Idaliella*) *pulchella* 307.
Janolus flagellatus Eliot.	Unchanged 325.
J. hyalinus (A. & H.).	,, 324.
Jorunna johnstoni (A. & H.).	*Jorunna tomentosa* 317.
Lamellidoris aspera (A. & H.).	*Onchidoris muricata* 295.
L. bilamellata (L.).	*Onchidoris fusca* 294.
L. depressa (A. & H.).	*Onchidoris depressa* 297.
L. diaphana (A. & H.).	*Onchidoris muricata* 295.
L. inconspicua (A. & H.).	*Onchidoris inconspicua* 298.
L. luteocincta M. Sars.	*Onchidoris* (*Atalodoris*) *luteocincta* 301.
L. muricata (Müll.).	*Onchidoris muricata* 295.
L. oblonga (A. & H.).	*Onchidoris oblonga* 299.
L. sparsa (A. & H.).	*Onchidoris sparsa* 296.
L. ulidiana (A. & H.).	prob. *Onchidoris muricata* 295.
Limapontia capitata (Müll.).	Unchanged 273.
L. depressa A. & H.	,, 274.
Lomanotus flavidus (A. & H.).	,, 328.
L. genei Verany.	*Lomanotus genei portlandicus* 326.
L. marmoratus (A. & H.).	Unchanged 327.
Palio lessoni (d'Orb.).	*Palio dubia* 287.
Palio ocellata A. & H.	*Palio nothus* 288.
Pleurophyllidia loveni Bergh.	*Armina loveni* 319.
Polycera quadrilineata (Müll.).	Unchanged 289.
Proctonotus mucroniferus (A. & H.).	*Zephyrina mucronifera* 322.
Rostanga coccinea (For.).	*Rostanga rufescens* 310.
Scyllæa pelagica L.	Unchanged 321.
Staurodoris maculata Garstang.	*Doridigitata sticta* (see *Journ. Conch.*, 20, p. 10).
S. verrucosa Cuv.	*Doridigitata derelicta* 315.
Stiliger bellulus (d'Orb.).	*Stiliger bellula* 269.
Tergipes despectus (Johnst.).	Unchanged 348.
Thecacera capitata A. & H.	,, 286.
T. pennigera (Mont.).	,, 284.
T. virescens A. & H.	,, 285.
Triopa claviger (Müll.).	*Limacia clavigera* 282.
Tritonia alba A. & H.	*Tritonia* (*Candellista*) *alba* 278.
Tritonia hombergii Cuv.	Unchanged 277.
T. lineata A. & H.	*Tritonia* (*Duvaucelia*) *lineata* 280.
T. plebeia Johnst.	*Tritonia* (*Duvaucelia*) *plebeia* 279.

SOME NEW AUSTRALIAN THERSITES.

By W. J. Clench and A. F. Archer.

(*Read before the Society, 9th January,* 1937.)

[Plate 1.]

The records and descriptions of the new species in this report are based upon material collected by H. L. Clark, P. J. Darlington, and W. E. Schevill during the Harvard Australian Expedition, 1931–2. A single species, *Thersites trachydermon*, is described from specimens in our collection received many years ago from C. E. Beddome.

Thersites darlingtoni, new species. Plate 1, fig. 2.

Shell rather large, imperforate, trochiform, rather thin with a dull surface. Whorls five, rather convex, the last definitely keeled. Colour, brown or dark brown slightly tinged with olivaceous. Parietal callus thin and of practically the same colour as the rest of the shell. Dark brown bands are formed below the suture and on the keel. Peristome and columella deep brown. Interior of aperture bluish white except for a greyish band following the line of the keel. Aperture oblique, subtriangular. Upper margin of peristome (palatal lip) slightly expanded, a little sinuous at the termination of the whorl angulation. Columellar margin reflexed and somewhat flattened. Suture somewhat indented. Sculpture consisting of axial striæ crosscut by raised irregular laminæ.

	Height. mm.	*Greater Diameter.* mm.	*Lesser Diameter.* mm.
Holotype .	31·3	45·2	40·6
Paratype .	30·9	40·5	36·5

Holotype.—Mus. Comp. Zoöl. no. 99054, MacPherson Range, Queensland National Park, 60 miles south of Brisbane, Queensland. P. J. Darlington collector, March, 1932. Paratype from the above locality.

Remarks.—This species differs from *T. novæhollandiæ* (Gray) in the following respects: The base of the shell is less convex; the keel is sharper and more "pinched out", the spire is higher and the suture more deeply impressed. One of the most important differences is to be found in the sculpture. In *T. darlingtoni* this consists of axial striations which are cross-cut by laminæ instead of being a series of fine, raised beading as is the case in *T. novæhollandiæ*. As compared with *T. richmondiana*, our species has a definitely less sharp keel.

THERSITES PTERINUS, new species. Plate 1, fig. 3.

Shell medium sized, umbilicate, depressedly globose, thin and with a dull surface. Whorls $5\frac{1}{4}$–$5\frac{1}{2}$, convex, and the last rounded. Colour, chestnut or chocolate-brown, early whorls pale brown; beginning with about the third whorl two deep yellow revolving bands are present, one at the periphery and one located just beneath a broad subsutural brown band. Parietal callus chestnut brown tinged with bluish and very thin. Peristome and columella deep chocolate brown. Interior of aperture bluish white with three brown bands or washes or colour present from peristome onwards, corresponding to the brown areas on the outside of the shell. Aperture oblique and lunately rounded. Peristome and columella expanded and rather thin. Suture moderately indented. Sculpture consisting of alternating series of short, raised lines cross-cutting the axial striæ at about 45°, giving the appearance of the barbs of a feather.

	Height.	*Greater Diameter.*	*Lesser Diameter.*
	mm.	mm.	mm.
Holotype .	27·5	35·9	32·7

Holotype.—Queensland Museum, Brisbane, from Lake Barrine, 25 miles south-west of Cairns, Queensland. P. J. Darlington collector, 1932. There is also a specimen from Lake Eacham, close to Lake Barrine, Northern Queensland, in the collection of the Museum of Zoology, Ann Arbor, Michigan, collected by F. N. Blanchard, 7th June, 1928.

Remarks.—This species is apparently one of the rarest finds in the genus *Thersites* and is only known from two specimens taken in the interior of Northern Queensland. It is nearest to *T. rainbirdi* (Cox) from which it differs in the following manner: the spire is less convex, the base of the shell is only narrowly umbilicate instead of having a wide, funnel-shaped umbilicus, and the peristome is narrower and more convex, with the aperture less descending. One of the most striking differences is in the sculpture, for in *T. pterinus* it consists of feather-like markings, while in *T. rainbirdi* it is gently striated in an axial plane.

THERSITES TRACHYDERMON, new species. Plate 1, fig. 5.

Shell umbilicate, globose-conoid, rather thin and with a dull surface. Whorls $5\frac{3}{4}$–6, moderately convex with the last whorl angulate. Colour uniformly dull yellow, faintly tinged with brown. Peristome ivory white. Interior of the aperture nearly white. Aperture slightly descending in front, roundly lunate. Peristome scarcely expanded in its upper part, but becoming gradually more expanded in its basal portion and merging imperceptibly with the

gently expanded columella. Parietal callus rather thin. Suture slightly indented. Sculpture consisting of rather widely spaced, axial riblets covered with very numerous spirally disposed elongate laminæ.

	Height.	*Greater Diameter.*	*Lesser Diameter.*
	mm.	mm.	mm.
Holotype .	21·6	30·0	27·0
Paratype .	23·9	31·9	27·7
,, .	22·0	28·1	25·9
,, .	21·9	29·9	27·0
,, .	21·6	29·0	26·6

Holotype.—Mus. Comp. Zoöl. no. 73284, 24 miles north-west of Cardwell, Queensland, Beddome collection. Additional paratypes from the same locality. This material belongs to a series sent to this museum by Beddome many years ago. It was provisionally named when the specimens were distributed among different museum collections, but was never published.

Remarks.—This species differs from *T. beddomæ* (Brazier) as follows: the periphery is angulate instead of being rounded, the peristome lacks the callus-like tooth, and the sculpture consists of spiral laminæ cross-cutting the axial ribs instead of being in the form of zig-zag granulations. *T. trachydermon* differs from *T. nicomede* (Brazier) in the more cone-shaped spire and in the elongate, spiral laminæ, contrasting with the pustulose laminations of the latter. The two species are rather near in size, but both are distinctly smaller than *T. beddomæ*.

THERSITES MONTICOLA, new species. Plate 1, fig. 4.

Shell umbilicate, subglobose and with a very dull surface. Whorls $6\frac{1}{4}$–$6\frac{1}{2}$, very gently increasing, convex, the last strongly so. Colour very light brown with a faint brownish band above and sometimes below the periphery. Peristome and columella white. Interior of aperture greyish. Aperture oblique, broadly lunate. Peristome gently expanded, but only weakly reflected. Columellar margin gently expanded. Suture moderately indented. Sculpture consisting of widely spaced, weakly developed axial riblets having a granulated surface and cross-cut by numerous elongate, spiral laminæ.

	Height.	*Greater Diameter.*	*Lesser Diameter.*
	mm.	mm.	mm.
Holotype .	18·6	29·0	26·4
Paratype .	18·5	29·9	27·1

Holotype.—Mus. Comp. Zoöl. no. 99053, Mount Spurgeon, 50 miles north-west of Cairns, Northern Queensland, P. J. Darlington collector, 1932. Paratype from same locality.

Remarks.—This species is most closely related to *T. coxenæ* (Brazier). The latter species was considered as belonging to the

genus *Chloritis* (H. A. Pilsbry, *Man. of Conch.*, 1894 (2), 9, p. 122), but is evidently a member of *Thersites*, judging from the shell characters and the fact that it appears closest to the species of *Thersites* having the laminate sculpture. *T. monticola* differs from *T. coxenæ* in having less rapidly expanding whorls, a more depressed spire, a less descending aperture, a rounded periphery not a carinated one, and in having spirally disposed, cuticular laminæ instead of axial pustules. It differs from *T. nicomede* (Brazier) in having less rapidly expanding whorls, a thicker cuticle, and long, slender laminæ instead of the short pustulose type of the latter species.

THERSITES SCHEVILLI, new species. Plate 1, fig. 1.

Shell rather narrowly umbilicate, globose, thin, and with a dull surface. Whorls $3\frac{3}{4}$–4, moderately increasing, convex, the last one rounded. Colour : periostracum pale brown over a dirty white background. Peristome white. Interior of aperture white. Aperture oblique, subcircular. Peristome rather sharp, only slightly reflected. Columellar margin expanded. Parietal callus rather thin. Sculpture consisting of axial ridges, sometimes broken up into irregular pustules.

	Height.	*Greater Diameter.*	*Lesser Diameter.*
	mm.	mm.	mm.
Holotype .	15·9	18·8	16·1

The paratypes present the following extremes in measurement : height, 12·8–15·1 mm. ; greater diameter, 15·7–17·7 mm. ; and lesser diameter, 13·2–15·2 mm.

Holotype.—Mus. Comp. Zoöl. no. 99055, foot of Mount Walker, south of Hughenden, Queensland, W. E. Schevill collector, 1932. Paratypes from same locality and also a specimen from Pelican Bore, Stewart's Creek, " Charlotte Plains," 50 miles north-west of Hughenden.

Remarks.—This species is very close to *T. nullarborica* (Tate). Both the species are desert snails and very similar in their external morphology, but are widely separated geographically. *T. nullarborica* inhabits the southern part of Western Australia. *T. schevilli* differs from it in the following particulars : the spire is somewhat less elevated, the whorls are fewer, the outer peristome is less strongly descending, and the sculpture consists of axial ridges which are not crossed by spiral striæ, as is the case in the latter species.

In addition to the above described forms the following species were collected by members of the expedition :—

Thersites bipartita (Fér.).—Lankelly Creek, McIlwraith Range, Cape York ; Cooktown, Queensland. (P. J. D.)

Thersites bipartita webbi Pils.—Mountain View, Mulgrave River, 14 miles south of Cairns; Bellenden-Ker Range, 25 miles south of Cairns, Queensland. (W. E. S.)

Thersites semicastanea (Pfr.).—Coen, Cape York, Queensland. (P. J. D.)

Thersites fraseri (Gray).—Queensland National Park, 60 miles south of Brisbane (P. J. D.); Bunya Mts., 100 miles north-west of Brisbane. (W. E. S.)

Thersites incei (Pfr.).—Mundubbera, Burnett River, 90 miles west of Maryborough, Queensland. (W. E. S.)

Thersites pomum (Pfr.).—Victoria, Port Essington, Coburg Peninsula, Northern Territory. (H. L. C.).

Thersites jannelli (LeGuill.).—Lankelly Creek, McIlwraith Range, Cape York; Coen, Cape York. (P. J. D.)

Thersites novæhollandiæ (Gray).—Barrington Tops, 135 miles north of Sydney, N.S.W. (P. J. D.)

Thersites bellendenkerensis Braz.—Bellenden-Ker Range, 25 miles south of Cairns, Queensland. (W. E. S.)

Thersites angasiana (Pfr.).—Finke River, James Range, 75 miles south-west of Alice Springs, Central Australia. (W. E. S.)

Thersites perinflata (Pfr.).—Soda Creek, 40 miles west of Barrow Creek Telegraph Station; Finke River, Glen Helen, MacDonnell Ranges, Central Australia. (W. E. S.)

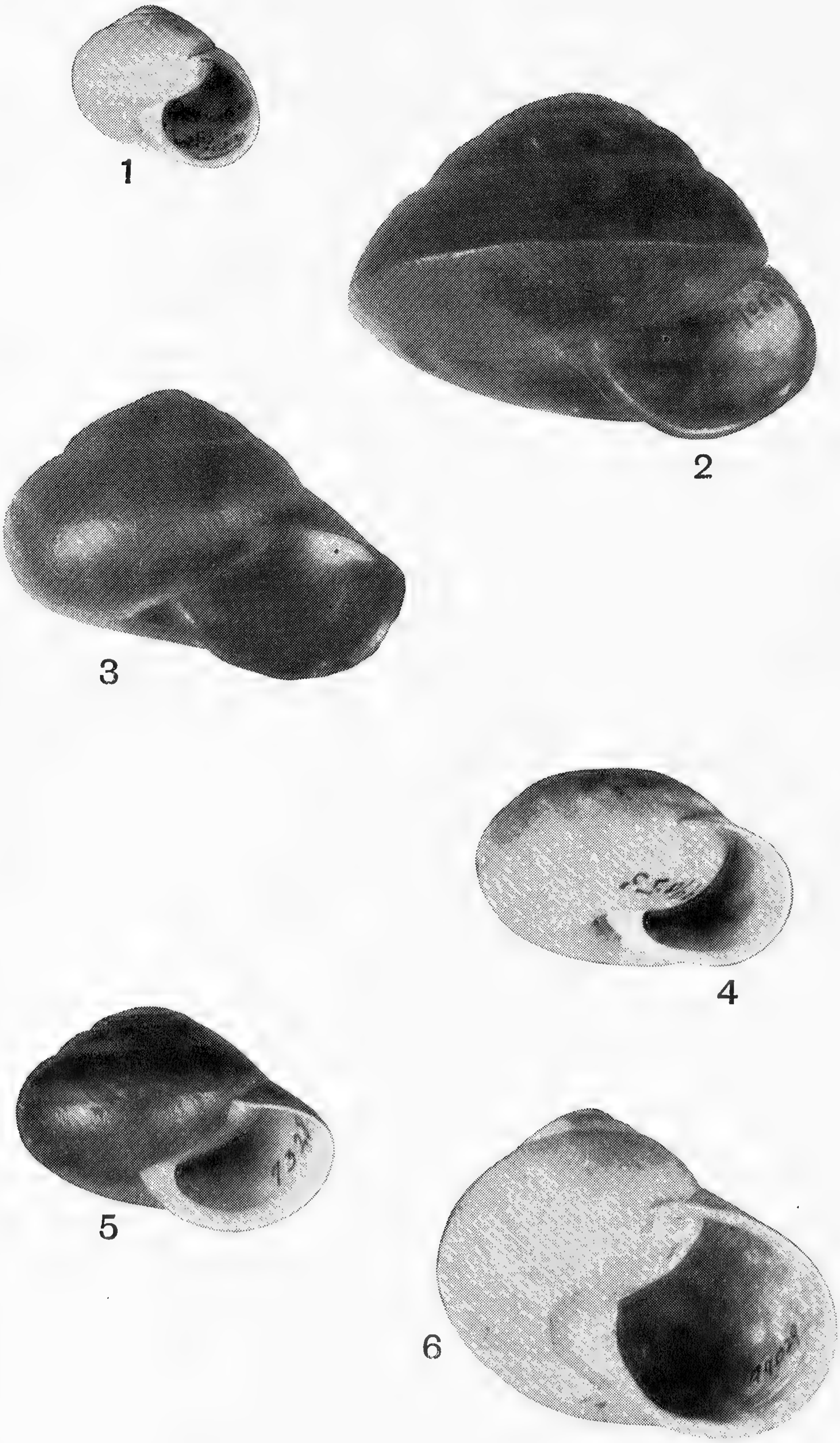
Chloritis banneri ("MacGill." Pfr.), Plate 1, fig. 6.—Lankelly Creek, McIlwraith Range, Cape York. (P. J. D.). This species was placed under *Thersites* in Pilsbry, *Man. Conch.*, 1894 (2), 9, p. 135. Judging from the figure given in vol. 6 the specimen was certainly a member of Section *Xanthomelon* of the genus *Thersites*. However, this could not have been the species which Pfeiffer had before him (*Proc. Zool. Soc. London*, 1862, p. 270). The published figure in J. C. Cox's *Monograph Aust. Land Shells*, 1868, p. 6, pl. 20, figs. 6–6*a*, shows a quite different type of snail. The shell characters and sculpture indicate that this species should be placed under section *Austrochloritis* of the genus *Chloritis*.

Type series of the species herein described that were collected by the Expedition have been deposited in the Queensland Museum, Brisbane.

PLATE 1.

(All figures natural size.)

FIG. 1.—*Thersites schevilli* Cl. & Ar. Holotype.
,, 2.—*Thersites darlingtoni* Cl. & Ar. Holotype.
,, 3.—*Thersites pterinus* Cl. & Ar. Holotype.
,, 4.—*Thersites monticola* Cl & Ar. Holotype.
,, 5.—*Thersites trachydermon* Cl. & Ar. Holotype.
,, 6.—*Chloritis banneri* ("MacGill." Pfr.).



Some New Australian Thersites.

See p. 24.

EDITORIAL NOTES.

It is with very great regret that we have to chronicle the death of Henry Crowther, the last surviving Founder of our Society, at the age of 89.

Crowther was one of the four men who met at Nelson's house in Leeds on 12th October, 1876, and decided to form " The Conchological Club " (see this Journal, Vol. 18, pp. 65, 68). An obituary notice will appear in due course.

The number of interesting and valuable papers on Mollusca seems to be ever on the increase. We have only space to notice a few of these.

In the summer of 1935 the Biological Society of Edinburgh University organized an expedition to investigate the fauna and flora of Barra in the Outer Hebrides. Their results have appeared in a paper of over 50 pages, *Proc. R. Phys. Soc. Edinburgh*, vol. xxii, pp. 241–296, with a map of Barra, and A. R. Waterston has had a large share, both in the editing and in working out the material.

Of Marine Mollusca 61 species were collected, nearly all in a living state, and 51 land and fresh-water Mollusca.

In the *South Australian Naturalist* for March, 1937 (vol. xvi, no. 4)—we are very glad to see that publication has been resumed—four Palæarctic snails are recorded as introduced into South Australia, viz. *E. pisana*, *H. ericetorum*, *Cochlicella acuta*, and *H. caperata*. All are illustrated on plate 1 ; the figures are not very clear, but *E. pisana* looks correct. About the other three we have considerable doubt and should like to see actual specimens. In the same article Mr. B. C. Cotton records *H. aspersa* as only too plentiful, and *Testacella haliotidea*, first taken at Adelaide in 1931.

The Field Naturalists' Club of Victoria is issuing a series of handbooks on Victorian fauna and flora, and no. 2 on " Victorian Sea Shells ", by C. J. Gabriel with illustrations by Joyce K. Allan, appeared in 1936. This guide gives us descriptions and figures of some 150 species, all of which may be collected at Port Phillip Bay. The descriptions and notes on habitat, etc., are good and adequate, the figures fairly recognizable but rather rough. It seems a pity that the names inscribed at the foot of the plates are English ones only.

Whether these are invented by the author one does not know, but there seems to be no practical use in such designations as the " Donax-like Razor ", the " Ridged Venerid " or the " Oval-shaped Trough Shell ". We feel sure that the beginner would just as readily memorize the Latin names.

We have not so far mentioned Boycott and Oldham's paper on the " Moll. of the Western Parts of the Shropshire Union Canal," N.W. Nat. for September, 1936. The paper is based on intensive collecting over a length of some 50 miles, from Llantisilio near Llangollen, through Frankton and Welshpool, to Newtown, Mont.

The sources of the water in the canal and the characteristics of its flow are very carefully described, and constant analyses were taken of the amount of calcium per litre. The molluscan fauna of this stretch of canal consists of 40 species—a good total considering the paucity of plants, and is elaborately discussed and classified according to the relative hardness of the water.

In 1925 Professors Grimpe and Wagler commenced to publish a series entitled " Die Tierwelt der Nord- und Ostsee." Lief. 29, which appeared rather more than a year ago, contains the Prosobranchs by W. E. Ankel of Giessen.

It is a monograph prepared with the usual German thoroughness and attention to detail, consisting of 240 pp. and 222 text-figures, which give a most adequate illustration of anatomy, conchology, radulae, and life-histories.

There is a full systematic catalogue of species and the favourite German method of a Bestimmungstabelle of families.

The classification seems on the whole up-to-date, though we find the family of the Pleurotomidae, and the geographical range throughout is excellently given. Altogether a most adequate and valuable piece of work.

Messrs. B. T. Batsford, Ltd., of 15 North Audley Street, W. 1, have been issuing a series of illustrated numbers entitled *Art and Nature in Colour*, the latest is called *Wonders of the Sea, Shells*, and consists of fifteen coloured plates by Paul A. Robert, with text by A. Masarey, figuring over forty species. Selection and arrangement by Dr. Hans Zbinden. The shells are beautifully drawn, coloured, and reproduced, and we have never seen figures quite so faithful to nature, either in colouring or in pattern. It is difficult to select figures for special commendation—perhaps those of *Tellina astrolabei* and the three Cones may be singled out. It is only a pity that the selector chose an example of *C. princeps* which has obviously had the lip on the grindstone. The price is 5*s*. 6*d*. net.

Dr. Marie V. Lebour is constantly adding to her series of valuable papers on the early stages of British Mollusca. The latest appeared last November, as usual in the *Journal of the Marine Biological Association*, and is entitled "The Eggs and Larvæ of the British Prosobranchs with special Reference to those Living in the Plankton". We have here in some 60 pages a compendium of what is hitherto known on the subject, conveniently arranged systematically, with four pages of figures.

Nucella lapillus L. at Knott End, Fleetwood.—A further visit to the locality described in this *Journal*, Vol. 20, p. 361, was made on 17th June, 1937, and it was then found that the colony still existed, and apparently was extending its area. It was interesting to note that a few young shells were to be found as this shows that the continuity of the species is assured for some time to come. Conversation with a local resident brought forth the fact that the sewage works which had been in existence for a few years now are having an appreciable effect upon the cleansing of the river mouth and consequently the shell life of the district will improve and benefit by this agency.—C. H. Moore. (*Read before the Society, 13th November, 1937.*)

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN & IRELAND.

644th Meeting, held at the Manchester Museum, 4th September, 1937.

Mr. C. H. Moore in the chair.

The Librarian reported additions to the Cabinet and Library and the usual periodicals received in exchange.

Papers Read.

" *Ashfordia granulata* (Alder) on Achill Island," by C. Oldham.

" *Pisidium lilljeborgii* Cless. in Glamorgan," by C. Oldham.

" *Sphærium pallidum* Gray and *Sphærium transversum* Say," by A. E. Boycott and C. Oldham.

" *Limnæa stagnalis* in Dew-ponds," by A. E. Boycott and C. Oldham.

" A Note on Some Characteristics of *Bulinus* and *Physopsis*," by F. G. Cawston.

" *Pisidium conventus* in Westmorland and Cumberland," by C. Oldham.

Exhibits.

By Mr. C. H. Moore : *Phasianella* spp. from various localities ; *Nucella crispata* from Victoria, B.C. ; and very large example of *Potamides palustris* L.

By the Free Public Museums, Liverpool (per Mrs. McMillan) : Series of *Nucella lapillus* (L.), *Gibbula umbilicalis* (da Costa), and *Litt. saxatilis* (Olivi) from numerous localities, illustrating variation in form and colour ; *Petricola pholadiformis* Lam. from Sutton-on-Sea, Lincs., where it is abundant burrowing in the boulder-clay.

645th Meeting (Annual Meeting), held in the Rooms of the Royal Society, London, 9th October, 1937.

The President (Lieut.-Col. A. J. Peile) in the chair.

Present : Messrs. J. R. le B. Tomlin, C. Diver, G. C. Spence, G. Shrubsole, A. S. Kennard, J. E. Cooper, G. L. Wilkins, A. Blok, A. E. Ellis, R. A. Priske, J. E. Forrest, F. Taylor, C. Oldham, Drs. E. H. Madge and J. W. Jackson, Mr. and Mrs. Winckworth, Mr. and Mrs. Davey, Mr. and Mrs. Worsfold, Mrs. A. J. Peile, Mrs. Bowell, Mrs. and Miss Morehouse.

Appointment of Scrutineers.

Messrs. A. Blok and W. J. Davey were elected Scrutineers.

Appointment of Auditors.

Messrs. C. H. Moore and A. K. Lawson were re-elected Auditors.

Resignation of Member.

W. H. Davies.

Paper Read in Title.

" An apparently undescribed Species of *Potadoma*," by M. Connolly.

Annual Reports.

The Annual Report of the Council ; the Reports of the London, Leeds, and North Staffs Branches ; the Reports of the Curator and the Recorders for Marine and Non-Marine Mollusca were presented and adopted.

Election of Officers and Council for 1937-8.

The Scrutineers reported that the Officers and Council for the ensuing year as nominated had been unanimously elected. (See p. 1.)

Votes of Thanks.

On the motion of the newly-elected President, Captain C. Diver, a cordial vote of thanks was passed to Lieut.-Col. Peile for his services during the year.

A vote of thanks was also passed to the authorities of the Manchester Museum for the use of rooms for the meetings of the Society.

The members and their friends were then entertained to tea by Lieut.-Col. and Mrs. Peile.

Exhibits.

By Mr. H. W. Worsfold : Shells showing some special variation of form.

By Major M. Connolly : *Potadoma tigrinum*, an apparently undescribed species.

By Mr. R. Winckworth : Examples of sixty-seven species of Mitridæ collected by Colonel H. C. Winckworth in the Andamans. *Daronia subdisjuncta* H. Ad. from the Andamans (H. C. W.)—the animal shows relationship with *Vanikoro*, and Col. Peile has shown that the radula also is related to that of *Vanikoro* and is probably nearer to that of *Fossarus*.

By the Librarian of the Royal Society : (1) Grew's Museum of the Royal Society ; (2) Exploration de l'Egypte, the largest book on mollusca.

By Lieut.-Col. Peile and Dr. E. H. Madge : Mascarene Vertiginidæ ; Mascarene species of *Gibbus*, *Gonidomus*, and *Gonospira* ; drawings of new spp. by Dr. Madge ; radula and penial spines of *G. palangus* and *G. chloris*.

By Mr. C. Oldham : *Lymnæa pereger* from Schwarzsee, Zermatt, 9.ix.37, at 8,393 feet ; *Zoögenetes harpa* (Say), from the Riffelalp, Zermatt, 15.ix.37, *ca.* 7,000 feet.

By Mr. L. E. Adams : *Anodonta* and other shells showing attacks by enemies.

By Mr. J. E. Cooper : Twenty-four of the smaller species of *Murex*, including *scorpio* L., *rota* Sow., *pinnatus* Wood, *clavus* Kiener, *axicornis* Lam., and *rosarium* Wood.

By Mr. W. J. Davey : Gems from the Philippines in *Helicostyla* and *Chloræa*.

By Mr. J. R. le B. Tomlin : *Perissodonta mirabilis* (Smith) ; thirty-five species of *Opisthostoma*—all the known species except *depauperatum* Smith ; the type specimen of *Conus vespertinus* Sow. (=*timorensis* Brug.), figured in 1825 in the Tankerville Catalogue ; the type specimen and another of *Conus adamsonii* Brod. (ex coll. Adamson) ; two *Thatcheria mirabilis* Angas—a species described from a unique shell in 1877, and until quite lately regarded as a monstrosity.

By Mrs. Morehouse : Bornean land-shells collected by Charles Hose in 1891, including five species of *Opisthostoma*, *Pterocyclos niahensis* G.-A., *Cyclophorus talboti* G.-A., *Pseudobba* (two species), *Opisthoporus pterocycloides* Pfr., and *O. hungerfordi* G.-A.

By Mr. F. Taylor : Land-shells from Bolton-le-Sands, including *Ashfordia granulata* and *C. acicula* ; from Eggerslack Woods, including *Vertigo alpestris* and *V. pusilla* ; from Derwentwater and Ingleton and elsewhere ; *Clausilia biplicata* and v. *alba* from Purfleet—specimens taken and cleaned in April showed no sign of eggs or fry, but others cleaned in June contained eggs or fry in various stages of development.

By Mr. G. L. Wilkins : Driftwood from Manorbier, Pembs., containing *Teredo megotara* Hanley and *T. malleolus* Turton.

ANNUAL REPORT, 1936-7.

This is the Sixty-first Annual Report of the Society. Since the last Annual Meeting one member, John Davy Dean, an ex-President, has passed away, four members have resigned, and two others have been struck off the list through non-payment of arrears of subscription. This makes a total loss of seven. Two Institutional Members and seven Ordinary Members have been elected during the year. The membership is now 217, including three Honorary Members and nine Institutional Members.

Six ordinary meetings have been held at the Manchester Museum through the kindness of the authorities. A joint meeting was held at Leeds in November (see this *Journal*, vol. 20, p. 317) and a similar one at Manchester in April (see p. 371).

Five Special Exhibits took place during the year, and twenty-six notes and papers were read.

Since the last Annual Meeting four numbers of the *Journal of Conchology* have been issued, viz. vol. 20, no. 9, 25th November, 1936, with 32 pages of text, 2 plates, and 5 text-figures ; no. 10, 18th March, 1937, with 32 pages of text and 2 text-figures ; no. 11, 27th May, 1937, with 8 pages of text and 14 text-figures ; and no. 12, 23rd September, 1937, with 52 pages of text with index, concluding the volume. The Society is greatly indebted to Mr. H. H. Bloomer, F.L.S., for defraying the entire cost of the blocks and of the printing of no. 11.

Additions to the Library have been received from Drs. A. E. Boycott and J. W. Jackson, Miss Van Bentham Jutting, Messrs. H. H. Bloomer, C. Oldham, C. M. Steenberg, H. Schlesch, and Shintaro Hirase. In addition Mr. Bloomer has given a collection of woodcuts of Unios and Anodons by Joseph Wilcock, formerly in the Standen-Jackson collection.

Additions to the Cabinet have been received from Mr. Hans Schlesch (portraits of conchologists) and from Mr. Fred Taylor (*Unio pictorum* and *Anodonta cygnea* from the Droylsden Canal, Lancs).

RECORDER'S REPORT (Non-Marine Mollusca).

Since the last report (Vol. 20, p. 313) forty-five new records have been authenticated for the census. The most important discoveries are those of *Pisidium lilljeborgii* in Glamorgan, by C. Oldham, and of *Limnæa stagnalis* in the Lake District, by T. T. Macan, who has also confirmed the very old record of *Amphipeplea glutinosa* for Windermere.

Devon, S. (3). *Anodonta anatina* (F. H. Rowley), *Pisidium henslowanum* (C. O.), *P. obtusale* (A. S. Kennard).

Devon, N. (4). *Helix cantiana*, *Limnæa auricularia*, *Pisidium henslowanum*, *P. obtusale* (C. Oldham and A. E. Boycott).

Somerset, S. (5). *Limnæa auricularia*, *Paludestrina jenkinsi*, *Bithinia leachii*, *Anodonta anatina*, *Unio tumidus*, *U. pictorum* (C. O. and A. E. B.).

Dorset (9). *Pisidium henslowanum* (L. B. Langmead).

Kent, E. (15). *Pisidium supinum* (A. S. Kennard).

Kent, W. (16). *Hyalinia lucida* (H. & I. Groves), *Pisidium henslowanum*, *P. supinum* (A. S. Kennard).

Essex, N. (19). *Pisidium obtusale* (A. S. Kennard).

Norfolk, W. (28). *Pisidium cinereum* (A. S. Kennard).

Gloucester, E. (33). *Physa heterostropha* (A. E. B.).

Gloucester, W. (34). *Milax gracilis* (C. O. and A. E. B.).

Hereford (36). *Bithinia leachii* (A. Wood).

Glamorgan (41). *Pisidium henslowanum*, *P. lilljeborjii* (C. O.).

Cheshire (58). *Phytia myosotis* (N. Fisher).

Westmorland (69). *Limnæa stagnalis*, *Planorbis fartanus*, *Pisidium personatum*, *P. conventus* (T. T. Macan).

Cumberland (70). *Pisidium conventus* (H. Overton).
Dumfries (72). *Paludestrina jenkinsi, Phytia myosotis* (E. A. T. Nicol).
Berwick (81). *Hyalinia rogersi* (W. J. Fairbairn).
Easterness (96). *Sphærium corneum* (D. K. Kevan).
Ebudes, N. (104). *Pisidium obtusale, P. pulchellum* (G. H. Harrison).
Ross, E. (106). *Pisidium personatum* (A. S. Kennard).
Orkney (111). *Planorbis contortus, Paludestrina stagnalis* (E. A. T. N.).
Mayo, W. (138). *Ashfordia granulata* (C. O.).

MARINE RECORDER'S REPORT.

During the past year some progress has been made in filling in the distribution maps of the British area, but much remains to be done and more helpers are wanted. The maps cannot be brought up to date without full lists of the species occurring in many areas if we adhere strictly to our present policy of not entering any animals without recent first-hand reliable records, and the greatest difficulty of procuring such records has been experienced in the case of common species. The importance of sending in such lists is seen from the fact that of 13 records for the district of St. Bride's Bay, sent in by Miss E. A. Buch, no less than 6 were new; Dr. Eales and Miss White returned a list of 34 species from Robin Hood's Bay, and of these I had no previous record of 12.

Miss K. M. White recorded *Tonicella marmorea* (Fabricius), *Balcis devians* (Monterosato), *Limapontia capitata* (Müller), *Ægires punctilucens* (Orbigny), *Eolidina glauca* (A. & H.), and *Skeneopsis planorbis* (Fabricius) from the Isle of Man; these were additions to the fauna of the Island. She also confirmed the occurrence of *Adalaria proxima* (A. & H.), *Acanthodoris pilosa* (Abildgaard), *Chlamys distorta* (da Costa), *Tritonia lineata* (A. & H.), and *Tritonia plebeia* (Johnston).

Mrs. McMillan has once more given valuable help both by sending lists and by the gift of two publications. In one of these, the *Irish Naturalists' Journal*, is a paper of hers mentioning 12 species of nudibranchs, of which *Acteonia cocksii* (A. & H.), *Limapontia capitata* (Müll.), *Ancula cristata* (Alder), *Jorunna tomentosa* (Cuvier), and *Facelina longicornis* (Mont.) are new for Antrim, and *Limapontia* for Down also.

Aided by the second book, *A list of the Marine Mollusca of Ireland*, by A. R. Nichols, it should be possible to make good progress.

W. F. Lloyd James reports *Callista chione* (Linné) and *Chamelea striatula* (da Costa) for Newport, Pemb. These are new for region IX*b*.

W. Fowler has again helped with lists from Scilly, Teignmouth, Anglesea, and West Scotland. Up to now I have found nothing actually new in these, the confirmation of *Clathrus turtonis* (Turton) off Teignmouth is interesting.

He dredged numerous species at Onich, including two *Emarginula crassa anassa* (Dean), and a second *Tropidomya abbreviata* (Forbes). These seem to be new to Upper Loch Linnhe. Mrs. Morehouse sent voucher specimens from Penzance, Porthcurnow, and Sennen. There was nothing new for these places, as could only be expected in such well worked stations.

One point of interest arises here: The absence of *Cantharidus exasperatus* (Pennant), at one time so common at Porthcurnow. *Caecum imperforatum* (Kanmacher), *C. glabrum* (Montagu), many Rissoidæ and Pyramidellidæ, as well as *Ixartia distorta* (Montagu), and many other shells once very common, were absent also. Thirty-five years ago these occurred in great numbers, but have become rare or absent during the last fifteen years. In the same way *Bela rugulosa derelicta* (Reeve) no longer occurs at Trebetherick cove, where it was discovered by William Tellum. It is difficult to see the cause of these facts. We may suffer a further loss of some species, such as *Devonia perrieri* (Mallard), *Lepton squamosum* (Montagu), and other denisons of the zostera zone, through the progressive destruction of this plant on our coasts. Spirit material of *Berthella plumula* (Montagu) and *Berthellina engeli* sp. nov. is again asked for.

ACCOUNTS FOR THE YEAR ENDED 31st DECEMBER, 1937.

Income and Expenditure Account.

Dr.

	£ s. d.	£ s. d.	£ s. d.
To Annual Subscriptions—			
For 1937—			
131 at 10*s*.	65 10 0		
2 at 7*s*. 6*d*.	15 0		
15 at 5*s*.	3 15 0		
		70 0 0	
Arrears		7 8 0	
			77 8 0
,, Sale of Publications			26 10 11
,, Advertisements			1 19 0
,, Donation to Publication Costs			14 9 0
,, Transfer from Life Membership Fund			16 8 0
			£136 14 11

Cr.

	£ s. d.	£ s. d.	£ s. d.
By publishing and distributing *Journal of Conchology*, Vol. XX.			
Pt. 10	21 2 11		
Pt. 11	13 1 6		
Pt. 12	34 4 9		
		68 9 2	
Authors' Reprints		7 6 0	
			75 15 2
,, Repairs to Cabinet			1 14 6
,, Printing and Stationery			2 7 6
,, Fire Insurance			10 0
,, Warehousing Stock			1 10 0
,, Expenses of Annual Meeting			6 14 0
,, Subscriptions—			
Malacological Society		1 1 0	
Lancs. and Chesh. Fauna Com.		5 0	
Zoological Record		5 0	
			1 11 0
,, Officers' Expenses			4 13 9
,, Balance, being excess of Income over Expenditure			41 19 0
			£136 14 11

Life Membership Fund.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Amount of Fund, 1st January, 1937	348	18	0	By Transfer to Income and Expenditure Account	16	8	0
,, Composition Fee	6	6	0	,, Amount of Fund, 31st December, 1937	355	4	0
,, Dividends and Interest	16	8	0				
	£371	12	0		£371	12	0

Research Fund.

	£	s.	d.		£	s.	d.
To Amount of Fund, 1st January, 1937	245	2	9	By Amount of Fund, 31st December, 1937	256	18	3
,, Dividends and Interest	11	15	6				
	£256	18	3		£256	18	3

BALANCE SHEET.

Liabilities.				£	s.	d.	Assets.				£	s.	d.
							Investments.	£	s.	d.			
Annual Subscriptions paid in advance				5	0	0	4% Funding Loan, £408 4*s.* 11*d.*, cost	350	0	0			
Provision for Glass-topped Boxes				1	5	0	$4\frac{1}{2}$% Conversion Loan, £202 13*s.* 3*d.*, cost	200	0	0			
Life Membership Fund				355	4	0	$3\frac{1}{2}$% Conversion Loan, £40 11*s.* 8*d.*, cost	40	0	0			
Research Fund				256	18	3					590	0	0
Balance of Income and Expenditure Account—							Cash at Bankers				102	9	0
As on 1st January, 1937	32	2	9										
For 1937	41	19	0										
				74	1	9							
				£692	9	0					£692	9	0

NOTE.—Assets in addition to those set out in the Balance Sheet are (*a*) Library, (*b*) Cabinets and Collections, (*c*) Stock of unsold publications, (*d*) Annual Subscriptions in arrear.

Audited and found correct.
C. H. MOORE.
A. K. LAWSON.
17th January, 1938.

CHAS. OLDHAM,
Hon. Treasurer,
31st December, 1937.

VOL. 21] 16TH JUNE, 1938. [No. 2

.. THE ..

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— OF —
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The University,
Manchester, 13.

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CONTENTS.

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THE
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VOL. 21. 16th JUNE, 1938. No. 2

THE BRITISH SPECIES OF ANODONTA LAMARCK, AND THEIR VARIETIES.[1]

By H. H. BLOOMER, F.L.S.

(*Read before the Society, 13th November, 1937.*)

[PLATES 2–9.]

INTRODUCTION.

Owing to an unfortunate and unexplained error the following was omitted at the bottom of page 1 in no. 1 :—

NORTH STAFFORDSHIRE BRANCH.

President: W. E. ALKINS, D.Sc.
Hon. Secretary: B. BRYAN.

been variously treated according to the different schools of con-

[1] Ortmann divided the *Unionidæ* into three sub-families, *Unioninæ*, *Anodontinæ*, and *Lampsilinæ*, with the genus *Anodonta* included in the *Anodontinæ*.

It may then be asked: What is really the relative position of *Anodonta* in the *Unionidæ* ? If the question is approached from a consideration of the shell alone, I think it must be conceded that this genus, and possibly the other genera of the *Anodontinæ*, show, in comparison with the remaining genera of the *Unionidæ*, features of degeneration ; while, apart from the *Anodontinæ*, some genera, and particularly those of North America, exhibit in this respect a strong tendency to specialization.

Specialization, however, is not confined to the shell only, but is present more or less throughout the *Unionidæ* in the varying adaptation of the gills to function as marsupia. The gills having to act in the dual capacity of organs of respiration and brood pouches for the young it would seemingly follow that any modification of them achieving both these functions in a more efficient manner must rank higher in the evolutionary scale of the *Unionidæ*. Ortmann has pointed out the greater development of the marsupial gill in the *Anodontinæ* ; thus in *Anodonta* is disclosed the contrast of what appears to be a degenerating shell with a more specialized type of outer gills.

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[PLATES 2–9.]

INTRODUCTION.

THIS work was begun in 1927 in collaboration with H. Overton, but, through unforeseen circumstances, was laid aside for several years. On resumption H. Overton found that, owing to lack of time at his disposal, he was unable to continue, so I have pursued the task alone. I, however, wish gratefully to acknowledge the help given by him in the earlier stages, but since I have considerably revised the original draft it is only just that I should assume full responsibility for the whole of the contents.

The classification of the European Anodontas, has, in the past, been variously treated according to the different schools of con-

[1] Ortmann divided the *Unionidæ* into three sub-families, *Unioninæ*, *Anodontinæ*, and *Lampsilinæ*, with the genus *Anodonta* included in the *Anodontinæ*.

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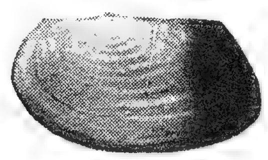
Specialization, however, is not confined to the shell only, but is present more or less throughout the *Unionidæ* in the varying adaptation of the gills to function as marsupia. The gills having to act in the dual capacity of organs of respiration and brood pouches for the young it would seemingly follow that any modification of them achieving both these functions in a more efficient manner must rank higher in the evolutionary scale of the *Unionidæ*. Ortmann has pointed out the greater development of the marsupial gill in the *Anodontinæ*; thus in *Anodonta* is disclosed the contrast of what appears to be a degenerating shell with a more specialized type of outer gills.

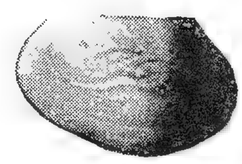
chology. On the Continent it has varied from one to a large number of species, and German opinion, during recent years, has trended towards one species.[2] In this country opinion, so far as British examples are concerned, was formerly divided between one and two species, though from my information two species are now more generally recognized. C. T. Simpson [3] dealt with the European Anodontas as one species after expressing his inability " to separate these forms specifically ", and A. E. Ortmann [4] concluded from an anatomical examination of a large number that there is only one species.

In 1917 H. Overton and H. H. Bloomer [5] argued that from the characters of the shell as well as the structure of the animal there are two British species. In 1925 an important contribution to the subject was made by A. S. Kennard, A. E. Salisbury, and B. B. Woodward [6] in which, besides other features, they demonstrated that the arrangement of the umbonal rugæ has a very significant bearing in discriminating between the two species.

The following photographic reproductions of very young shells from Llyn Coron, Anglesey, collected by Charles Oldham, show not only the difference in the arrangement of the umbonal rugæ but the general shell characters of the two species. The examples also are interesting in that they both were taken from the same lake.



A. cygnea × 2.



A. anatina × 2.

---

[2] W. Israël, *Biologie der europäischen Süsswassermuscheln*, n.d. Two species—one, the group of *Anodonta cygnea* L. divided into forms ; the other, *A. complanata* Ziegler ; see p. 15.

A. Locard, *Les Coquilles des eaux douces et saumâtres de France* (1893). *Anodonta* is divided into about 250 species, but this number is considerably reduced by other French authorities.

F. Haas, in a communication to me, states that until he is convinced by anatomical and biological evidence to the contrary he recognizes only one species, *A. cygnea*, in Middle and West Europe.

[3] " Synopsis of the Naiades," *Proc. U.S. Mus.*, vol. 22, p. 621 (1900).

[4] " Notes upon the families and genera of the Najades," *Annals Carnegie Museum*, vol. 8, p. 286 (1912).

[5] " On Anodonta cygnea, A. anatina, and Pseudanodonta rothomagensis," *Proc. Malac. Soc. Lond.*, vol. 12, pt. 5, p. 202 (1917). The forms chosen were (*a*) *A. cygnea*, one between the type and its variety *zellensis*, and (*b*) *A. anatina*, one allied to the variety *piscinalis*, both forms being more suitable for the purpose and convenient to obtain at the time.

[6] " Notes on the British Post-Pliocene Unionidæ," *Proc. Malac. Soc. Lond.*, vol. 16, pt. 6, p. 269 (1925).

I have recently described in a general manner the way in which the shell of *A. cygnea* can be distinguished from that of *A. anatina*,[7] have also made reference to the external characters of the animal of both species and shown wherein they differ from each other [8]; consequently it is unnecessary to enter afresh into such detail, but the fact should be remembered that it is not uncommon to find both *A. cygnea* and *A. anatina* inhabiting the same water.[9] In such places the two kinds may live not far from each other and still retain distinctive shell and morphological features and may not hybridize. Certainly there are places where there are signs that seem to indicate that hybridization does occur; hybridization may not be so very rare and may even be present in more localities than is generally supposed, since in a few waters from which a large number of shells has been examined a few have come under suspicion through having characters that suggest an affinity with both *A. cygnea* and *A. anatina.* However, the point I want to emphasize is that in closed waters, and in a number of instances too, the prevailing forms are still referable to these two species, each form retaining its characteristic features that seem to persist and not to disappear.

While the difference between *A. cygnea* and *A. anatina* has been stressed, and though, as will shortly be seen, the means seem available for fully describing the type of *A. cygnea*, yet it is not possible to give with the same assurance a similar description of *A. anatina.*

The varieties of both *A. cygnea* and *A. anatina* (I believe the retention of "variety" instead of "sub-species" is advisable in the present circumstances), with a few exceptions, are even more difficult to identify with exactitude—a great deal of uncertainty being created by inadequate or contradictory descriptions and further complicated by reference to unfortunate illustrations. Gmelin's *zellensis* is readily recognizable by his cited illustration from Schröter, and Nilsson's *piscinalis*, by his description and comparison with *A. anatina*, is placed, in my view, in an identifiable position; these are the two most important varieties.

Some varieties are described from Continental shells and it is not always easy to decide if there are British ones similar to them; moreover, the question arises as to how far some forms are sufficiently distinctive and consistent to merit the status of variety. Notwithstanding these uncertainties I have deemed it prudent to include

---

[7] *Journ. Conch.*, vol. 20, No. 11, p. 321 (1937).
[8] *Proc. Malac. Soc. Lond.*, vol. 22, pt. 3, p. 130 (1936).
[9] "The British Anodontas," *Journ. Conch.*, vol. 19, No. 1, p. 11 (1930).

the described varieties recognized by later authorities and leave conchologists to work out those cases in which the claim to varietal rank can be sustained.

As just intimated it will be more advantageous to give a full description of *A. cygnea* marked "218" (cf. *Linn. Syst. Nat.*, 10th ed., p. 706, 1758) in the Linnean collection because there are very strong grounds for believing it to be the type used by Linné. It is the right valve of the shell only, but in the same glass-topped box is placed a detached left valve, which resembles the former in size, shape, and colour of the periostracum.

The number 218 on the outer side and the word *cygneus* on the inner side of the valve are, in the opinion of the late B. Daydon Jackson, in the handwriting of Linnæus. S. Savage, the librarian and assistant secretary of the Linnean Society, who also is familiar with the handwriting of Linnæus, is of this opinion too.

The varieties of *A. cygnea* described are :—

(*a*) *radiata* of Müller. I am not at all sure that it should be included here. Müller says it is intermediate between *A. cygnea* and *A. anatina*. Jeffreys first places it as a variety of *A. cygnea*, saying it is *stagnalis* of Gmelin and *dentatus* of Turton (*Conch. Dict.*) and *paludosus* of Turton (*Brit. Bivalves*), and then furnishes another example as a variety of *A. anatina*, adding "the rayed markings form scarcely a varietal character, being common to half-grown individuals of the last [*cygnea*], as well as this, species". L. E. Adams (*Brit. L. & F.W. Shells*) similarly gives both, and Kennard and Woodward [10] include it under the section of *A. anatina*, but Mr. Kennard, in a letter of a more recent date, says he suspects the reliability of Müller's judgment on the position of this variety, and is doubtful if Müller correctly identified either *A. cygnea* or *A. anatina* because of the perplexity arising from his cited illustrations of these species.

(*b*) *stagnalis* of Gmelin. Probably a very large form near the type.

(*c*) *zellensis* of Gmelin is a common form of *A. cygnea*, but in a number of localities where *zellensis* is prevalent many of the shells may vary in shape between it and the type.

(*d*) *pallida* of Jeffreys, distinguished by the pale colouring of the periostracum.

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[10] A. S. Kennard and B. B. Woodward, *Synonymy of the British Non-Marine Mollusca* (1926).

In *A. anatina* some divergence of opinion seems to exist concerning the exact nature of the typical shell. Linné, in his description, uses the word " fragilissima ", and this term, with relatively few exceptions, was substantially accepted by subsequent authorities, some describing the species, when not using the Latin, as very fragile, fragile, thin, or brittle. Nilsson, who first separated the variety *piscinalis* from the type, says *A. anatina* is thin, fragile, and variable in form. Rossmässler is practically in accord, and his description is further interesting in that he mentions the wavy-wrinkled umbonal rugæ, a characteristic feature of *A. anatina* in the widest sense; he was also aware of its variableness, since he refers to and illustrates several forms. Jeffreys describes *A. anatina* as being " not so thin as in the usual or typical form of the last species " (*A. cygnea*), but then he does not distinguish or include *piscinalis* in his work.

For a second example the first figure given by Rossmässler is chosen for an illustration of this variable species. Those cited by Nilsson, Pennant, da Costa, and Maton and Rackett are indifferent ones, but, after all, Lister's figure conveys a quite recognizable shell.

The varieties of *A. anatina* described are :—

(*a*) *avonensis* of Montagu. I have not seen an example and all my efforts to obtain one have proved fruitless.

(*b*) *intermedia* of Lamarck. By the assistance of Chemnitz's illustration and C. Pfeiffer's description an attempt is made to recognize this shell, but it is by no means certain that the desired result has been accomplished. I have failed to obtain or see an authenticated example from France, and F. Haas informs me that he regards *intermedia* as a " reaction-form of *A. cygnea* " without distinctive characters (see footnote, p. 34). However, as Chemnitz's figure and C. Pfeiffer's description as well as his illustration suggest a close connexion with *A. anatina* it is included as a variety of this species.

(*c*) *incrassata* of Sheppard. I was prepared to accept, with Jeffreys, Bean's designation of the Scarborough shell as the variety *incrassata*, though it is a variable shell, but Mr. Kennard, who possesses the Mason collection of fresh-water bivalves, which also includes Sheppard's shells, tells me that in the latter collection there is no shell named *incrassata* nor is there one that corresponds to the Scarborough shell; hence the claim for the Scarborough shell is abandoned and the variety itself remains undetermined.

(*d*) *piscinalis* of Nilsson. It is believed that Nilsson's description on the whole is sufficient to establish decisively this variety.

(*e*) *ventricosa* of C. Pfeiffer appears to be mainly a ventricose and elongated form allied to *piscinalis*.

(*f*) *ponderosa* of C. Pfeiffer. Jeffreys considered it to be the same as *incrassata*: though both are massive shells I cannot agree with his view, because examples from Beinsee (Beinseel), near Durlach, Germany, which, however, have not a scaly periostracum, show *ponderosa* to be a larger and broader (dorso-ventral measurement) shell, with the anterior end having a very broad curve; moreover, I have a specimen from Cheadle, Staffordshire, which, whilst not so large, resembles in shape and thickness the " Beinsee " *ponderosa*.

(*g*) *complanata* of Ziegler. It is explained later why this name is no longer available. Jeffreys was quite in error in associating the Gumfreston shell with Ziegler's *complanata*.

(*h*) *rostrata* of Rossmässler. Apparently a rostrate form of *A. anatina*, and sometimes in *piscinalis* this characteristic seems to become more accentuated as the animal grows older and the shell becomes comparatively large; there are, however, places where shells are more prone to this propensity at a much younger stage. Some forms of *A. cygnea* also show a pronounced rostrate tendency.

(*i*) *subrhombea* of Brown. I have failed to identify this shell.

Large as the number is of the varieties above described there are others that have been omitted, such as Lamarck's *sulcata*, Turton's *dentatus* or *paludosus*, Ray and Drouet's *dupuyi*, and Dillwyn's *fucatus*, because I have not been able to ascertain, quite apart from questions of synonymy and validity, to what extent they are genuinely represented by British shells.

It has to be admitted that at times a rather free translation has been made of the original description which in some instances has been abbreviated. Every effort has been directed not only to be consistent in the terms employed but as far as possible to retain a uniform method of description. Nevertheless, the hope is entertained that in no case has the meaning of the author been misinterpreted or any important detail omitted.

In addition to authorities mentioned I have derived considerable assistance from A. S. Kennard and B. B. Woodward's *Synonymy of the British Non-Marine Mollusca*, from correspondence in 1928 with the late B. B. Woodward and later from kind and helpful criticism by A. S. Kennard. I further wish to express thanks to N. F. Sharp of the British Museum (Department of Printed Books) for photographs of Lister's figures of *A. cygnea* and *A. anatina* in *Hist. Anim. Angl.* app. (1681), S. Savage and W. S. Warton of

the Linnean Society of London for a photograph of Linné's specimen 218 and information from works of reference; for specimens from P. Arnold, Professor A. E. Boycott, J. E. Cooper, the late P. T. Deakin, Dr. W. T. Elliott, the late W. Gyngell, Dr. F. Haas, A. Hartley, Dr. J. W. Jackson, B. R. Lucas, J. W. Moore, Chas. Oldham, H. Overton, A. Seidler, and R. Winckworth.

Description.

Anodonta cygnea L.

M. testa ovata antice compressiuscula fragilissima, cardine laterali. Linnæus, *Syst. Nat.*, 10th ed. (1758).

The following is a description of specimen No. 218 of the Linnean collection in the possession of the Linnean Society of London. It consists of the right valve only and measures 13·6 cm. by 7·2 cm. Whilst the posterior extremity is nearly intact a small piece is broken off above and another piece below it.

Shell ovate, a little ventricose, somewhat thin, but of even thickness except portions of the muscular scars; the outer surface shows at intervals a number of elevated concentric lines of growth with rather broad intervening parts, the whole rounded and smooth; dorsal edge straight and of medium length; anterior edge rounded but sloping and passing with a continuation of the curve into the ventral margin, the latter being relatively deeply curved; posterior part produced into a rounded, wedge-shaped extremity, compressed above and distinctly showing the gonial ridge (see Taylor's Monograph, vol. i, p. 45); periostracum thin, smooth, and decorticated in the upper part of the umbonal region with this part of the shell a little eroded in places. The colour of the remaining umbonal, as well as the adjoining region, is a drab-grey that shortly merges anteriorly and ventrally into a yellow or greenish yellow shade, and is afterwards interspersed in places with broad and generally alternating bands of a little deeper green or more yellow tinge. In the posterior part of the valve the green becomes more intense, particularly near the gonial ridge; the ridge has more of a dark green to brown shade, that spreads above it; umbo not prominent and the apex is situated, from the anterior edge, about one-third of the whole distance of the valve. Ligament mostly missing but from the appearance of the valve was rather long, not strongly developed, and was probably partly hidden by the overlapping edges of the shell. Umbonal rugæ coincident with the lines of growth, except that there is a small dislocation of them running ventrally, a little anteriorly to the mid-vertical line; the inner surface of the valve is a pearly white, but uneven through the

rounded and shallow concentric grooves that are in a large degree complementary to the outer elevated growth lines of the shell; muscular scars generally shallow, the anterior being a little more defined than the posterior ones, and the pallial scar is indistinct. Escutcheon a shallow but gradually expanding bay.

Kennard, Salisbury, and Woodward [11] say of *A. cygnea* :—

" Umbonal rugæ a well-marked series of concentric ridges, more or less coincident with the outline of the young shell and running from margin to margin on either side of the umbo, not always continuous, sometimes bifurcating."

Illustration cited by Linné. Lister, *Angl.*, app. 29, t. 1, f. 3.

J. W. Taylor and W. D. Roebuck, in their unpublished report dated 25th June, 1918, on the Freshwater shells in the Linnean Collection in the possession of the Linnean Society of London, remark :—

" *Anodonta cygnaea.* L. Two valves—one with the end broken off. Inscribed in ink ' 218 ' outside, ' *cygneus* ' inside, in what Dr. Daydon Jackson considered to be certainly the handwriting of the elder Linné. The specimen is yellowish-fawn tinged in parts with greenish, the posterior area being quite green.

Separated valves of one example referable in form to var. *cellensis* C. Pfeiffer. The specimen seems very tumid in the upper margin."

A. S. Kennard and B. B. Woodward [12] state :—

" *Anodonta* (*Mytilus* L.) *cygnea* (1).

" Of the two species now once more recognized as valid, the inscribed and numbered specimen in the collection with the figures cited (Lister, angl. app., t. 1, fig. 3, and Gualtieri, t. 7, f. F, the latter written against by Linné himself in his copy of the work) quite establishes its identity.

" The further quotation of Lister, ' conch., t. 193, fig. 8,' in the 10th edition of the 'Systema' (p. 706), should, as Hanley remarks, be ' 153 ', but both Linné and Hanley overlooked the fact that the figure in question is a reprint of Lister's Anim. Angl. append., pl. 1, fig. 2, adduced by Linné in illustration of his *anatinus*. This same figure copied by Klein (Ostr. t. 9, f. 26), is correctly cited by Gmelin under *anatinus*.

" The correct reference to Lister's Conch. should have been ' 156 ' which is the copy of the ' app. t. 1, f. 3 '."

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[11] Op. cit., p. 269.

[12] A. S. Kennard and B. B. Woodward, " On the Linnean Species of Non-Marine Mollusca that are represented in the British Fauna, with Notes on the Specimens of these and other British forms in the Linnean Collection," *Journal Linnean Society, London, Zoology*, vol. 34, No. 227, p. 215 (1920).

Specimens exactly resembling in shape the type are to be sparingly obtained and it will probably be difficult to find them corresponding in both shape and colouring.

A. cygnea, var. *radiata* Müller.

Description after Müller.[13]

Shell oval, very delicate, pellucid, yellowish with broad double yellowish green chamferings (striaturæ) towards the wedge; anteriorly slightly compressed in front of the umbones; shell-margin sharp, not membranous; several uneven deep green rays radiating from the umbones towards the periphery of the shell.

Illustration cited by Müller. Lister, *Hist. synops. conch.*, t. 155, f. 10.

As mentioned in the introduction, it is with some misgivings that this shell is classed as a variety of *A. cygnea* instead of *A. anatina*, but Müller's description seems to agree more with the former than the latter and Lister's figure cited by him does not much assist. Then again the reference to the chamferings passing from the umbonal region to the rostrum is probably the gonial ridge or a modification of it. Specimens of *A. cygnea* from Weston Turville reservoir and a pool near Astley, Chap Cross, show a slight depression running along the centre of the broad gonial ridge, giving the appearance of a double ridge, and have on the crest in the former example green against a yellowish general colour of the shell, and in the latter a darker green with a lighter green and yellow general colour of the shell.

The ridge is rather prominent in some specimens of *A. anatina* as well as in *A. cygnea*, and the deeper coloured rays are found in both species.

A. cygnea, var. *stagnalis* Gmelin.

M. testa ovali planiuscula transversim costata. Gmelin.[14]

Gmelin adds that it is near to *A. cygnea*, but the shell is far larger, even 8 inches long and $4\frac{1}{2}$ inches broad, and less convex, greenish with more obscure greenish rays, and towards the margin, of a distinct pale yellowish brown.

Illustration cited by Gmelin. Schröter,[15] *Flussconch.*, t. 1, f. 1.

Sowerby [16] in his description acknowledges that the one by

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[13] O. F. Müller, *Vermium terrestrium et fluviatilium historia*, pt. 2, p. 209 (1774).

[14] Linnæus, *Systema Naturæ*, ed. 13, cura J. F. Gmelin, p. 3362 (1791). Long and broad have been transposed to be comparable with E. A. Smith's measurements; therefore length now refers to antero-posterior measurement.

[15] J. S. Schröter, *Die Geschichte der Flussconchylien* (1779).

[16] James Sowerby, *British Miscellany*, p. 33, pl. 16 (1806).

Gmelin " agrees nearly with our shell, and we make no scruple of considering them as the same ".

Gmelin's description appears to convey the impression of a normally shaped *A. cygnea* that has grown to a very large size under favourable conditions and in comparatively quiet waters, whereas Sowerby's illustration suggests features of a different shell.

E. A. Smith [17] records these large shells and gives the measurements of one from near Preston, and now in the British Museum, with a length of $8\frac{3}{4}$ inches, height $4\frac{9}{16}$, diameter $3\frac{1}{8}$, girth $11\frac{7}{8}$; also another specimen from Claughton, Lancashire, $7\frac{5}{8}$ inches long.

A. cygnea, var. *zellensis* Gmelin.

Description after Gmelin [18] and C. Pfeiffer.[19]

Shell fairly large, elliptical-ovate, rather ventricose, fragile, concentrically ribbed; anterior end rounded; posterior part elongated and produced into an obtuse rostrum; ventral edge nearly straight or a little emarginate; periostracum greenish brown; umbonal parts flat with retuse and decorticated apices; escutcheon narrow and irregularly quadrangular; inner side of shell mother-of-pearl lustre and having an uneven surface that is partly complementary of the external ribbing.

Schröter's [20] name is usually associated with this variety but his work being non-binomial, priority should be given to Gmelin [21] who cites Schröter's figure 1 (t. 2), for his illustration. C. Pfeiffer's illustration (T. vi, 1825), is somewhat similar to that of Schröter.

Another illustration is given of a shell from the pool in Highams Park, Epping Forest, Essex.

The variety *zellensis* is generally distributed.

A. cygnea, var. *pallida* Jeffreys.[22]

" Shell light yellow or fawn coloured; hinge-line rather curved, and raised on the posterior side, which is produced to a long wedge-like point; lower margin rounded.

West of Ireland (Humphreys)."

Anodonta anatina L.

M. testa ovali compressiuscula fragillissima margine membranaceo, natibus decorticatis. Linnæus, *Syst. Nat.*, 10th ed. (1758).

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[17] Edgar A. Smith, " Note on a large specimen of *Anodonta cygnea*," *Proc. Malac. Soc.*, vol. 10, pt. 1, p. 4, March (1912).

[18] Linnæus, *Systema Naturæ*, ed. 13, cura J. F. Gmelin., p. 3362 (1791).

[19] Carl Pfeiffer, *Naturgeschichte deutscher Land- und Süsswasser-Mollusken*, p. 110 (1821).

[20] J. S. Schröter, op. cit.

[21] B. B. Woodward, in a letter to me.

[22] J. Gwyn Jeffreys, *British Conchology*, p. 42 (1862).

Description after Nilsson [23] and Rossmässler.[24]

Shell elliptical-ovate, moderately small, variable, thin, fragile, more or less compressed ; dorsal border sub-curved, a little ascending posteriorly ; anterior edge rounded, comparatively narrow ; ventral border a little curved, sometimes slightly retuse ; posterior part produced into a short angulated rostrum and compressed dorsally ; periostracum yellowish green or greenish grey to greenish brown, dull, concentrically and unevenly striated and wrinkled ; umbones situated near anterior end, more or less depressed with the apices a little raised ; umbonal rugæ generally wavy-wrinkled ; sometimes the apical parts decorticated ; ligament somewhat prominent and angular at the posterior end ; escutcheon broad, almost square.

" Umbonal rugæ finer, wavy, not always reaching the shell margin, not always continuous, not coincident with the lines of growth, and sometimes bifurcating." [25]

Illustration cited by Linné. Lister, *Angl.*, app. 30, t. 1, f. 2.

A second illustration is also given of Rossmässler's figure 417 (*Icon.*, pl. 30), and a third one of a shell from the Newport and Brecon Canal, near Llangynidr, Brecon.

J. W. Taylor and W. D. Roebuck (op. cit.) say :—

" *Anodonta anatina* L. Two examples, mounted on tablet by Mr. Hanley. One is the specimen which he figured in his ' Ipsa Linnæi Conchylia '. The second is now loose, broken off the tablet. The colouring is dull brownish green, very dark brown along the posterior upper margin.

" Hanley's figure seems correct for size of the larger shell but the bright orange umbo of the figure is in the shell itself just mother-of-pearl."

A. S. Kennard and B. B. Woodward [26] state :—

" *Anodonta* (*Mytilus* L.) *anatina*.

" Lister's figure (Anim. Angl. append., pl. 1, f. 2), originally cited in the first edition of the ' Fauna Svecica ', with the enlarged description in the ' Systema ' (10th ed., p. 706, No. 219), and in the second edition of the ' Fauna Svecica ' (No. 2158), convince us that the customary identification of this species is correct. The figure in Gualtieri added in the 12th edition of the ' Systema ' may or may not have been intended for a *Unio*, but lacks any hinge-teeth.

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[23] S. Nilsson, *Historia Molluscorum Sveciæ*, p. 114 (1822).

[24] E. A. Rossmässler, *Iconographie der Land- und Süsswasser-Mollusken*, 5 and 6 Heft, p. 57 (1837).

[25] A. S. Kennard, A. E. Salisbury, and B. B. Woodward, op. cit., p. 269.

[26] A. S. Kennard and B. B. Woodward, *On the Linnean Species of Non-Marine Mollusca*, p. 215.

This may have caused Linné to include it and possibly may account for his puzzling observation in the 10th edition of the 'Systema'—'similis Myæ pictorum, sed fragilior & cardine distinctissimus.'

"We do not agree with Hanley that Lister's 'f. 2' shows 'an ordinary example of the *Anodonta cygnea*', nor with his selection of the specimen figured by him in illustration, which, as the umbonal rugæ show, belongs to the genus *Pseudanodonta* (cf. *P. grateloupiana* (Gassies) or *P. normandi* (Dupuy). It is only fair to add, however, that this genus had not in his days been separated off from *Anodonta*."

Whilst *A. anatina* may be found in quiet waters it is probably more often present in rivers and faster streams than its variety *piscinalis*, yet it possibly has not such a wide and common distribution as *piscinalis*, sensu lat.

A. anatina, var. *avonensis* Montagu.[27]

Montagu says :—

"M. with a sub-oval shell of an olivaceous-brown colour, with concentric wrinkles ; size of the *M. anatinus*, but broader in proportion to its length, and not so produced at the hinge ; the posterior side generally more obtuse, and rounded ; the front margin nearly strait, or frequently sub-arcuated, particularly towards the smaller end.

"This shell we found in great abundance in the River Avon, about Lackham, in Wiltshire, where it is much more plentiful than the *Anatinus*.

"Possibly it has been confounded with that shell, we never found it except at the place before mentioned. It is not in general so thin as the preceding species [*M. anatinus*] ; in shape corresponds very well with Lister's figure of the shell here quoted, but in general it is more strait on the front margin, close to the posterior side, and frequently makes an angle at that part."

The figure referred to by Montagu is Lister, *Conch.*, t. 154, f. 9 ?

Maton and Rackett [28] give an illustration, a photographic reproduction of which is here shown, but do not add any further information.

Kennard, Salisbury, and Woodward [29] state that Maton and Rackett's figure suggests *Pseudanodonta*.

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[27] George Montagu, *Testacea Britannica*, p. 172 (1803). It would seem that in his description length is the dorso-ventral measurement and the frontal edge is the ventral one.

[28] W. G. Maton and T. Rackett, "A descriptive catalogue of the British Testacea," *Trans. Linn. Soc. Lond.*, vol. 8, p. 110, pl. 3A, f. 4 (1807).

[29] A. S. Kennard, A. E. Salisbury, and B. B. Woodward, op. cit., p. 270.

A. anatina, var. *intermedia* Lamarck.

Description after Lamarck [30] and C. Pfeiffer [31] chiefly the latter, as Lamarck's description is meagre but Chemnitz's illustration, cited by him, largely agrees with C. Pfeiffer's more detailed account although the figure given by the latter does not quite coincide with that of Chemnitz.

Shell rhomboidal-ovate, somewhat compressed, thin and brittle, concentrically ribbed, smooth, and polished; anterior and ventral margins rounded; dorsal edge straight and at the posterior end of the ligament compressed and alate; umbones blunt, flat, and wavy-wrinkled, very little decorticated; periostracum a beautiful yellowish green colour with partly indistinct green rays, but in the proximity of the apices of the shell a clear grey without the green rays; ligament almost hidden.

Illustration cited by Lamarck, *Chem. Syst. Conch. Cab.*, 8, t. 86, f. 763.

A. anatina, var. *incrassata* Sheppard.

Shell oval; anteriorly somewhat compressed; margins membraneous; umbones decorticated; posteriorly from the umbones to the base gradually incrassated; ligament much exposed.

Sheppard [32] observes that this is "a very distinct species, rough and dark coloured on the outside, thicker and stronger than the rest; the hinge towards the posterior extremity. Remarkable for its large exserted ligament; and posterior part, in a slope from the umbones to the base, being much incrassated, which gives that part in the inside a white milky appearance; whereas the rest is of a fine pearly hue.

"In the River Trent at Holme."

Sheppard's description (in it the posterior end obviously refers to the anterior one, see Taylor's monograph, vol. 1, p. 37) and his diagrammatic illustration indicate this shell to be a variety of *A. anatina*.

In the introduction the reason is stated why it is very doubtful if Bean's Scarborough shell, quoted by Jeffreys [33] to be the variety *incrassata*, can be accepted, but an illustration of a Scarborough shell is given for comparison.

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[30] Lamarck, *Histoire naturelle des Animaux sans Vertèbres*, vi, p. 86 (1819).

[31] Carl Pfeiffer, op. cit., p. 113, t. 6, f. 3 (1821).

[32] R. Sheppard, "On two new British Species of Mytilus," *Trans. Linn. Soc. Lond.*, vol. 13, p. 85 (1822).

[33] J. Gwyn Jeffreys, op. cit., p. 43.

A. anatina, var. *piscinalis* Nilsson.

Description after Nilsson.[34]

Shell elliptical-ovate, ventricose, a little thick, anteriorly rounded, posteriorly produced, and angular; dorsal margin straight and having posteriorly an angular ending; behind this angular margin the dorso-posterior part of the shell is straight or concave, the posterior extremity itself truncate; periostracum yellowish green colour, sometimes pale yellow, clothed with full and crowded rayed lines more or less conspicuous, marked with concentric striæ and zone-formed wrinkles of a brown colour; the apical parts of the shell are distant from the anterior end, rather prominent, red, and close together; umbones tumid and of a pale ash colour.

Nilsson in his observations mentions that whilst the general shape approaches very near to *A. anatina* yet the shell differs in being larger, more ventricose with thicker valves, and chiefly in the apical parts of the shell being more distant from the anterior extremity, somewhat prominent, and in possessing tumid umbones.

The illustration cited by Nilsson is Schröter, *Flussconch.*, t. 3, f. 1. Figure 18 is a shell from Wychall Pool, King's Norton, Worcestershire.

This variety, similarly to *A. anatina* itself, is very variable and it is not infrequent to find specimens that are difficult to allocate to one or the other; the variability extends to the position of the apices of the shell as well, so that if their greater distance from the anterior end, emphasized by Nilsson, is insisted upon as a characteristic feature of the variety, then that will lessen its distribution; otherwise *piscinalis* in its varied forms has a wider range and appears to be more common than *anatina*. Then, too, the colour of the periostracum is frequently darker than described by Nilsson; green and olive green, often of a dark shade, particularly in the posterior part of the shell, predominating.

A. anatina, var. *ventricosa* Pfeiffer.

Description after C. Pfeiffer.[35]

Shell ovate-oblong, a little thick and ventricose; anterior margin rounded; ventral border slightly curved; posterior part somewhat elongated with blunt rostrum; posterior portion of the dorsal part somewhat compressed and alate; periostracum dark grass green with brown concentric bands; umbones tumid with the apical parts a little prominent and bare of the periostracum; ligament in relation to the ventral border obliquely situated, and

[34] S. Nilsson, op. cit., p. 116.

[35] Carl Pfeiffer, op. cit., p. 30, t. 3, figs. 1–6 (1825).

ascending from anterior to posterior end, broad, and more or less exposed ; escutcheon passes from a narrow to a wide bay ; surface of the inner side of the shell is bluish white and iridescent.

Illustration. C. Pfeiffer, *Nat. Deut. Land- u. Süssw. Moll.*, t. 3, f. 4, 1825.

A. anatina, var. *ponderosa* C. Pfeiffer.

Description after C. Pfeiffer.[36]

Shell elliptical-ovate, massive, and ventricose ; anterior and posterior margins rounded ; dorsally rounded, a little compressed and posteriorly more so ; umbones depressed and eroded ; ligament broad, strong, and exposed ; depression to the rear of the apex expands into a moderately large escutcheon ; periostracum dark brown, unicoloured, rough, scaly, and in places decorticated ; inner surface of the shell white, a little opalescent, with deep muscular impressions.

Illustrations. C. Pfeiffer, *Nat. Deut. Land- u. Süssw. Moll.*, 1825, t. 4, f. 4, and a shell from Cheadle, Staffs.

Habitat. Pools and small flowing waters.

A. anatina, var. *complanata* Ziegler.

This variety, described by Rossmässler (*Icon.*, p. 112, 1835), has been stated to belong to the genus *Pseudanodonta* ; consequently it is inferred that the name is no longer available.[37]

The shell mentioned by Jeffreys (*Brit. Conch.*, i, p. 44), with the locality of Gumfreston, near Tenby, is obviously wrongly identified by him as being the same as *complanata*, because examples from this locality are a form of *anatina*. Whether the Gumfreston shell is similar to any described Continental variety is uncertain, and it is further questionable if this form merits such distinction. Illustrations, however, are given of Rossmässler's figure (No. 68*a*) and of a shell from Gumfreston.

A. anatina, var. *rostrata* (Kokeil) Rossmässler.

Description after Rossmässler.[38]

Shell of medium size, elongate, almost rhomboidal, thin, fragile, moderately compressed ; anterior margin rounded ; dorsal edge very short, ascending posteriorly a little curved or quite straight

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[36] Carl Pfeiffer, op. cit., p. 31, t. 4, figs. 1–6 (1825).

[37] F. Haas, " On Unio, Margaritana, Pseudanodonta, and their occurrence in the Thames Valley," *Proc. Malac. Soc. Lond.*, vol. 9, pt. 2, p. 109, June (1910).

A. S. Kennard, A. E. Salisbury, and B. B. Woodward, op. cit., p. 271.

[38] E. A. Rossmässler, op. cit., 4 Heft, p. 25 (1836).

and alate behind the umbones ; ventral border short and subretuse ; posterior part produced into an elongated but blunt rostrum ; umbones convex, wider in front, wavy, generally worn and situated near to the anterior end ; periostracum glossy, banded, brownish yellow or clear brown with spaced and raised narrow dark brown lines of growth and generally having three dark green rays on each side ; ligament exposed ; escutcheon narrow and denoted on both sides by dark green rays ; inner surface of the shell a bluish colour, iridescent ; muscular scars not deep.

Illustration. Rossmässler, *Icon.*, f. 284.

Rossmässler's figure 284 is evidently a variety of *A. anatina*, but concerning figure 737 one feels less sure ; he appeals (1842, p. 12) for stricter descriptions of these variable forms in order to prevent subsequent confusion.

Jeffreys [39] states that *rostrata* " appears to be the *Mytilus avonensis* of Montagu (*Test. Brit.*, p. 172), judging from his description and the figure of that species which is given by Maton and Rackett in the 'Linnean Transactions', vol. viii, pl. 3A, f. 4". With regard to Jeffreys' comment reference should be made to the description of the var. *avonensis*.

A. anatina, var. *subrhombea* Brown.[40]

" Shell thick, subrhomboidal, rather inflated ; anterior side slightly produced ; hinge-line nearly parallel, and ascending towards the posterior side ; ligament long, sub-arcuated, from whence it suddenly declines towards the somewhat truncated extremity ; basal line considerably arcuated ; exterior surface but slightly wrinkled transversely [concentrically] ; umbones small, and acute ; inside bluish-white, with faint pearlaceous reflections.

" This variety differs from the *A. piscinalis*, in being more ponderous, and more inflated, in the hinge line being more arcuated, and in being less rostrated."

Illustration. Brown, *Illust. L. and F. Conch.*, pl. 16, fig. 4.

" Found in the Irwell near Manchester " and " Dinting Vale near Glossop."

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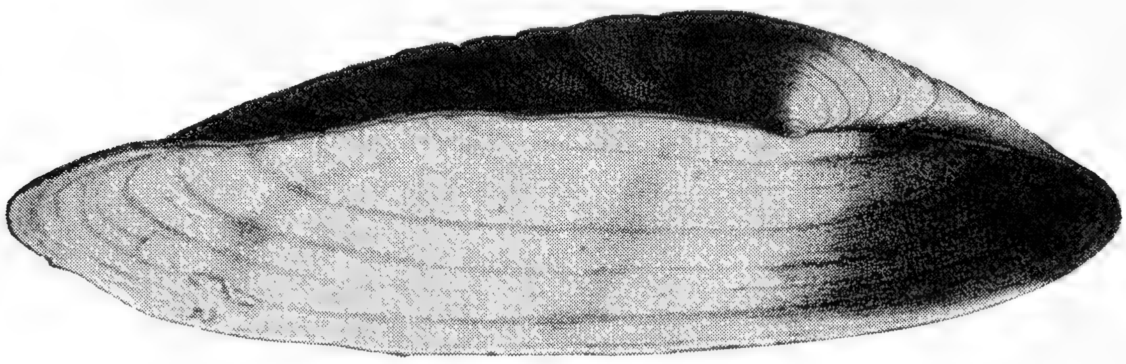
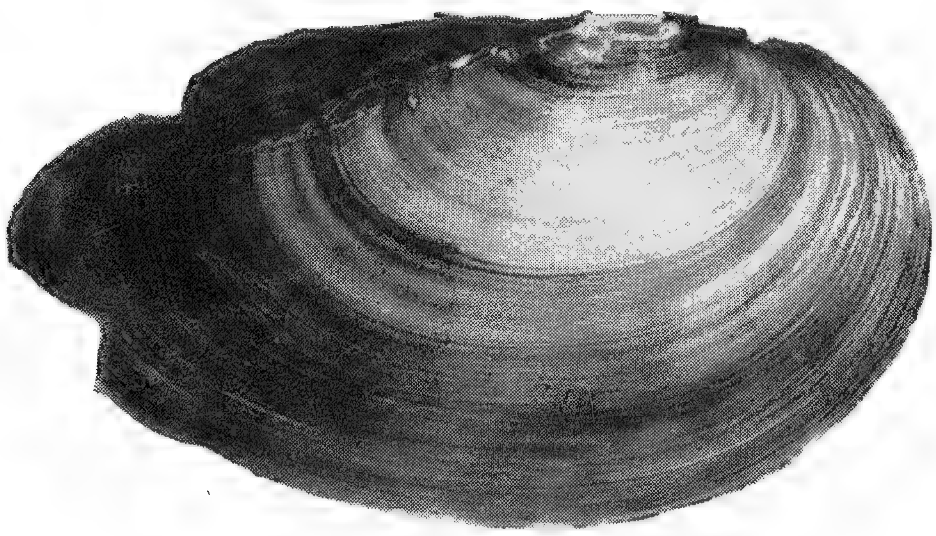
39 J. G. Jeffreys, op. cit., p. 43.

40 T. Brown, *Illustrated Conchology*, p. 80, pl. 30, f. 3 and 4. *Description from Illustrations of the Land and Freshwater Conchology of Great Britain and Ireland*, p. 104 (1845).

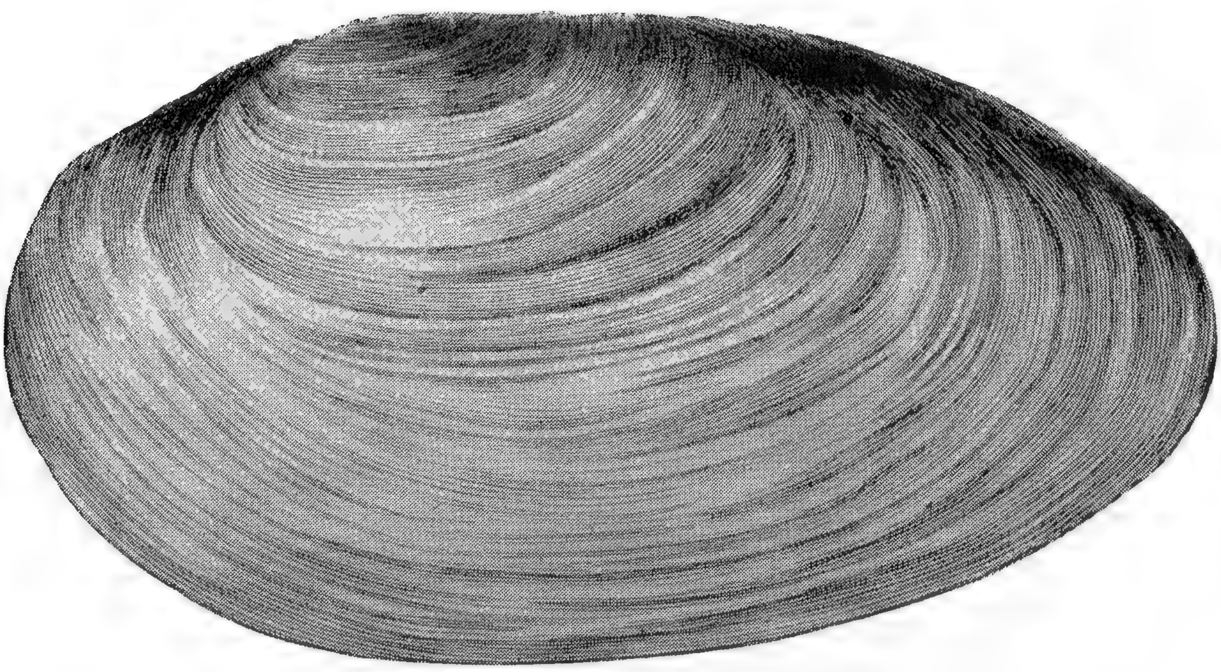
Anodonta cygnea L.



1. Lister, *Anim. Angl. append.*, t. 1, f. 3. × ·5.



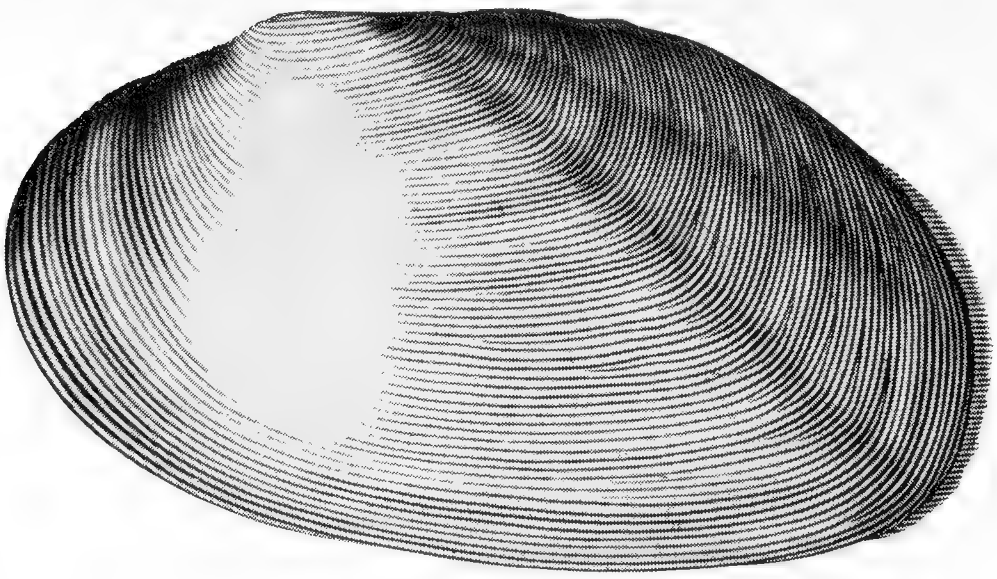
2. No. 218. Linnean Collection. × ·45.



3. Gualtieri, *Index Hist. Conch.*, t. 7, f. F. × ·52.

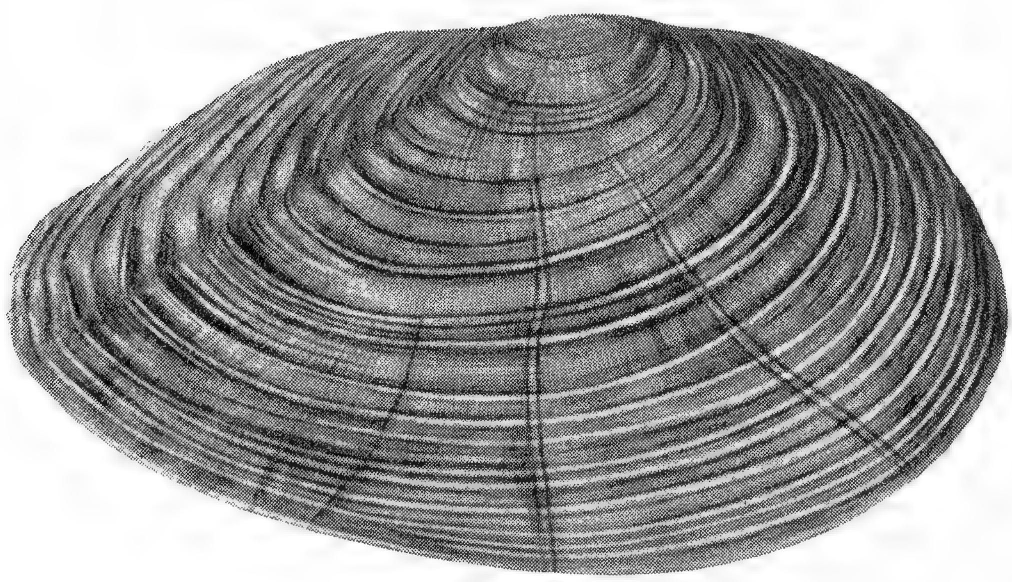
[*To face p.* 48.

A. cygnea, var. *radiata* Müller.

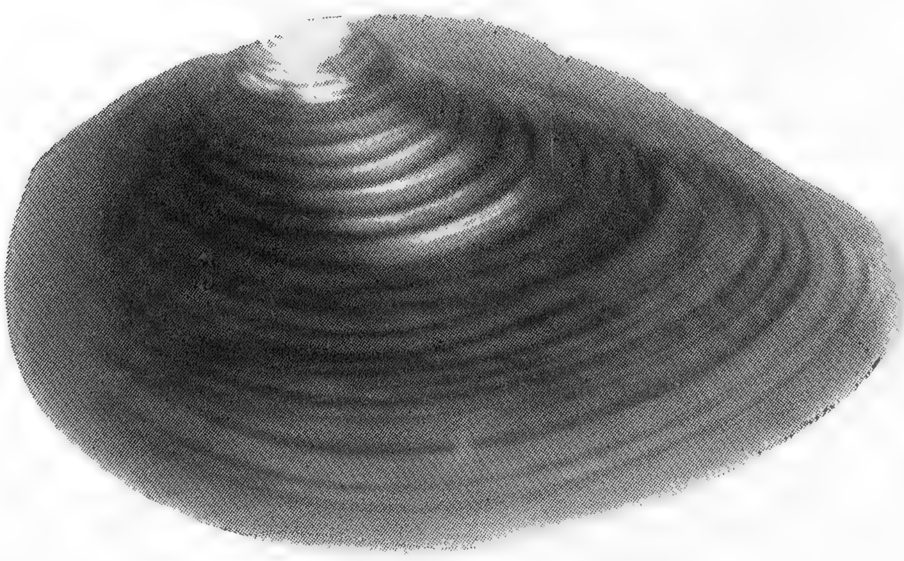


4. Lister, *Hist. Synops. Conch.*, t. 155, f. 10. × ·69.

A. cygnea, var. *stagnalis* Gmelin.

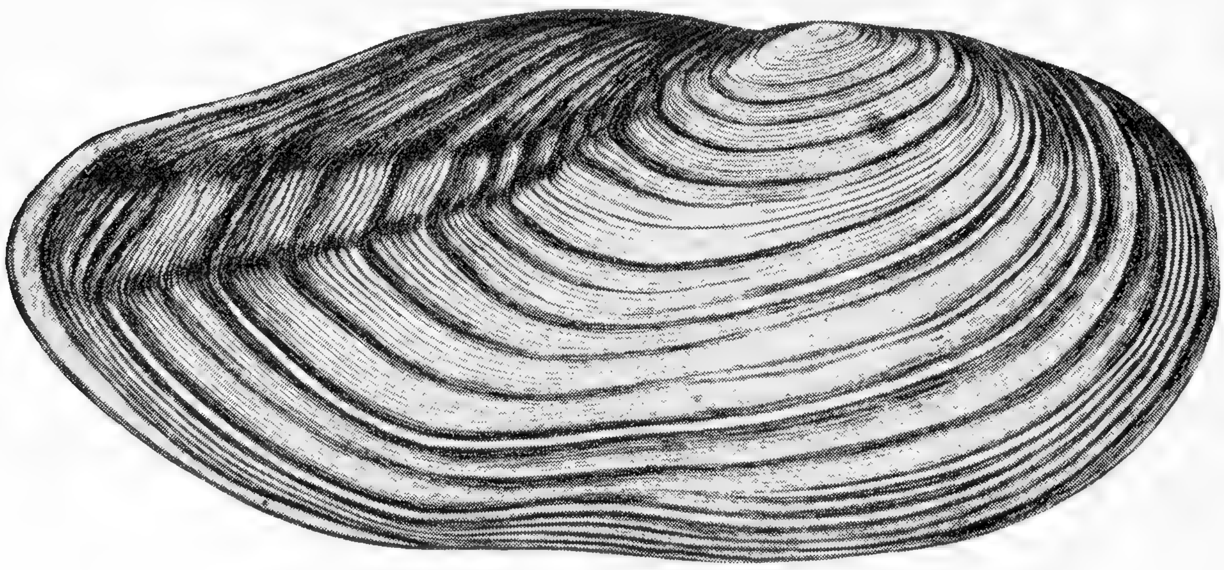


5. Schröter, *Gesch. Flussconch.*, t. 1, f. 1. × ·35.



6. Sowerby, *Brit. Miscell.*, p. 16. × ·35.

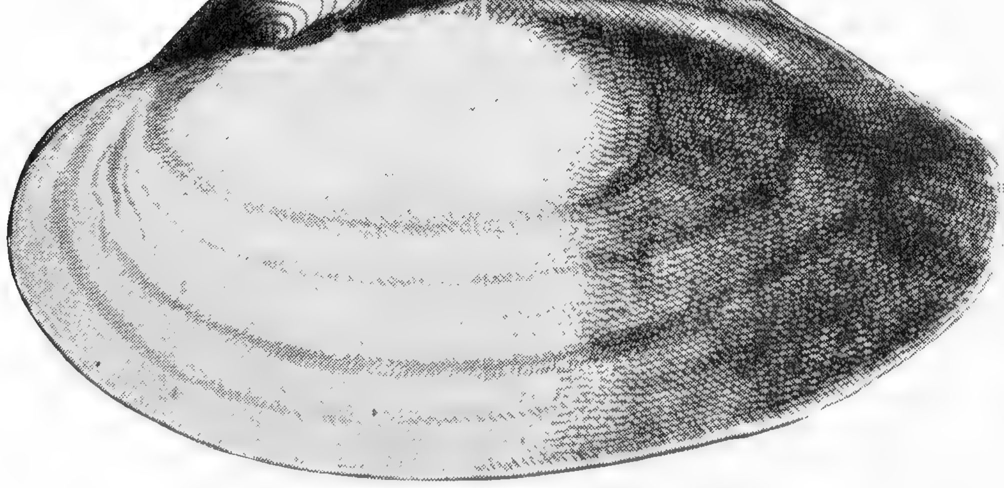
A. cygnea, var. *zellensis* Gmelin.



7. Schröter, *Gesch. Flussconch.*, t. 2, f. 1. × ·49.

8. Shell from pool in Highams Park, Epping Forest. × ·85.

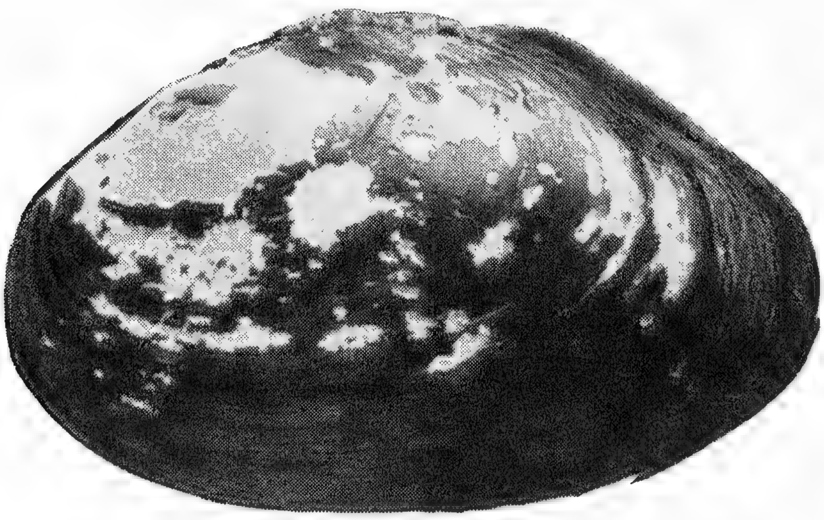
Anodonta anatina L.



9. Lister, *Anim. Angl. append.*, t. 1, f. 2. × ·72.

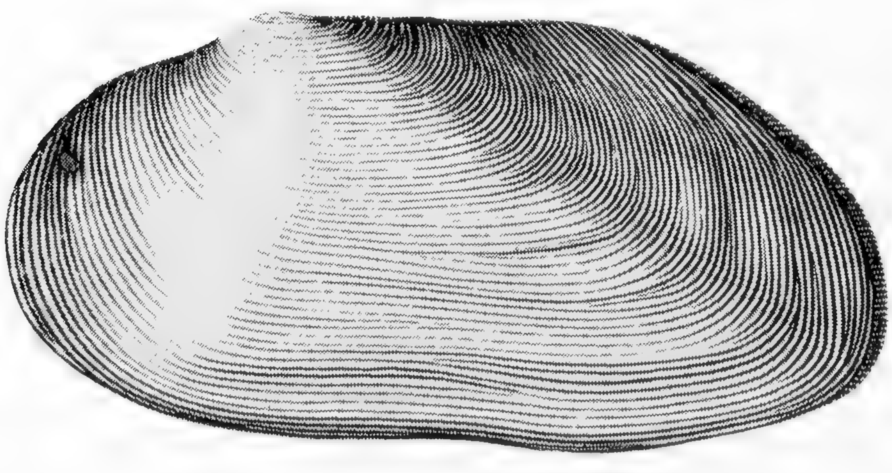
Anodonta anatina L.

10. Rossmässler, *Icon. L.- u. S. Moll.*, f. 417. × 1·04.



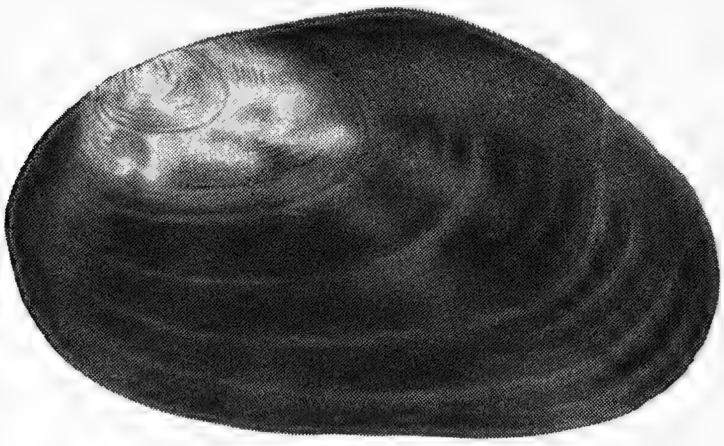
11. Shell from Newport and Brecon Canal, near Llangynidr, Brecon. × ·88.

A. anatina, var. *avonensis* Montagu.



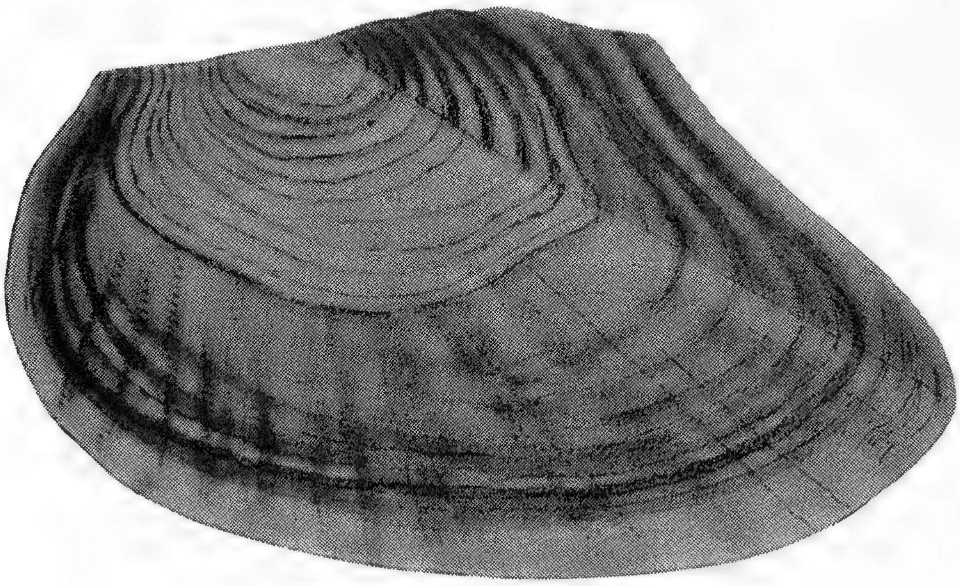
12. Lister, *Hist. Conch.*, t. 154, f. 9 ? × ·67.

A. anatina, var. *avonensis* Montagu.



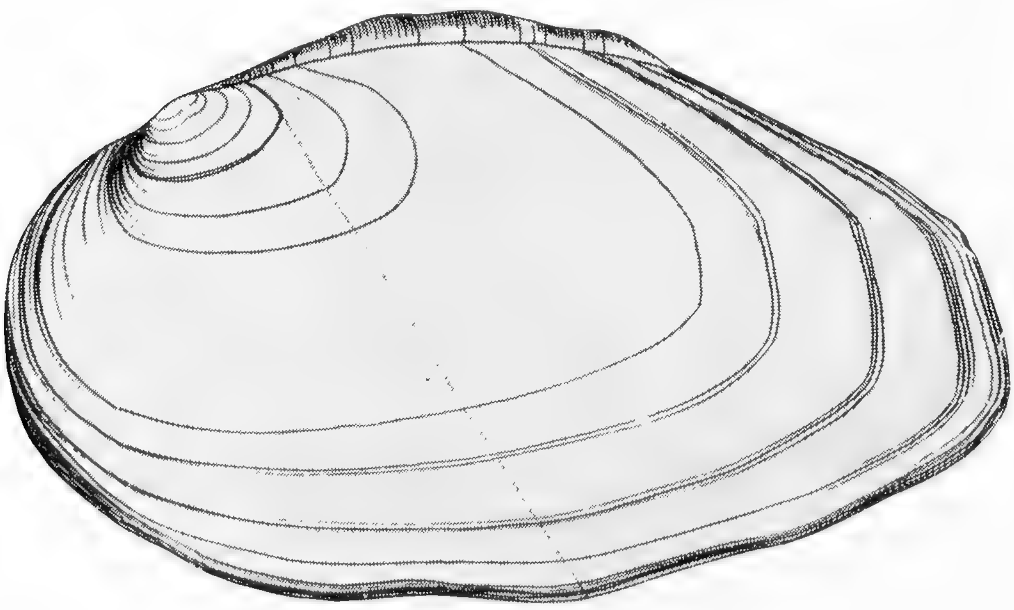
13. Maton and Rackett, *Cat. Brit. Test.*, pl. 3A, f. 4. × ·76.

A. anatina, var. *intermedia*, Lam.



14. Chemnitz, *Conch.*, t. 86, f. 763. × 1.

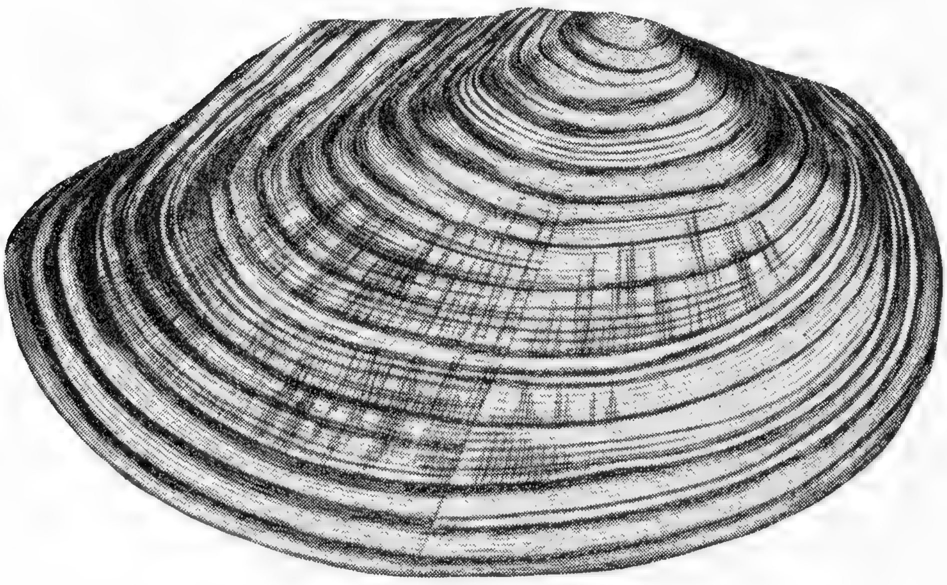
A. anatina, var. *incrassata* Sheppard.



15. Sheppard, *Brit. Spec. Mytilus*, pl. 5, f. 4. × ·6.

16. A Scarborough specimen. × ·5.

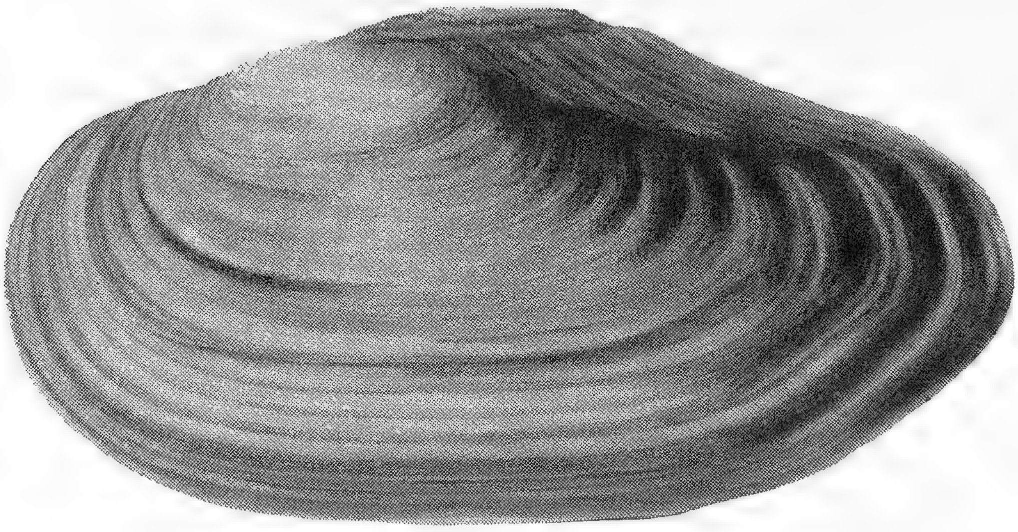
A. anatina, var. *piscinalis* Nilsson.



17. Schröter, *Gesch. Flussconch.*, t. 3, f. 1. × ·48.

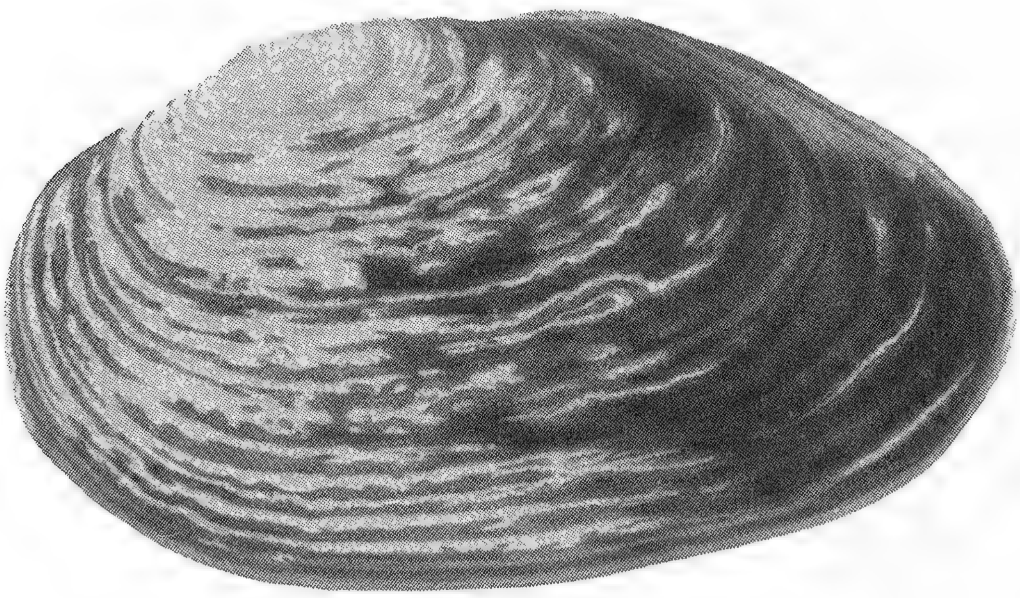
18. Shell from Wychall pool, Worcestershire. × ·71.

A. anatina, var. *ventricosa* Pfeiffer.

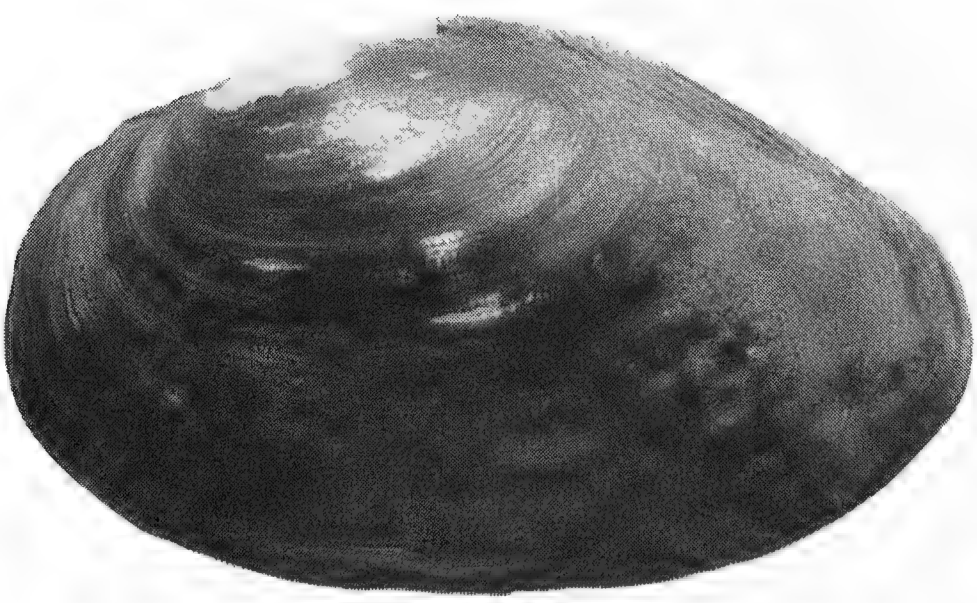


19. C. Pfeiffer, *Nat. Deut. L.- u. S. Moll.*, t. 3, f. 4. × ·5.

A. anatina, var. *ponderosa* Pfeiffer.

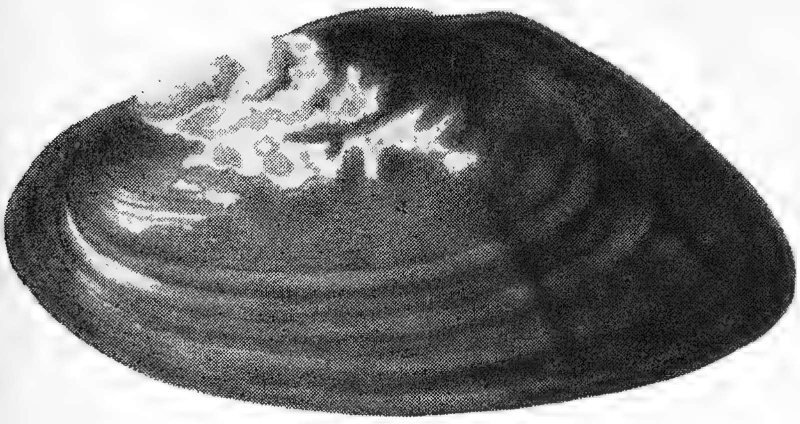


20. C. Pfeiffer, *Nat. Deut. L.- u. S. Moll.*, t. 4, f. 4. × ·46.



21. Shell from Cheadle, Staffs. × ·49.

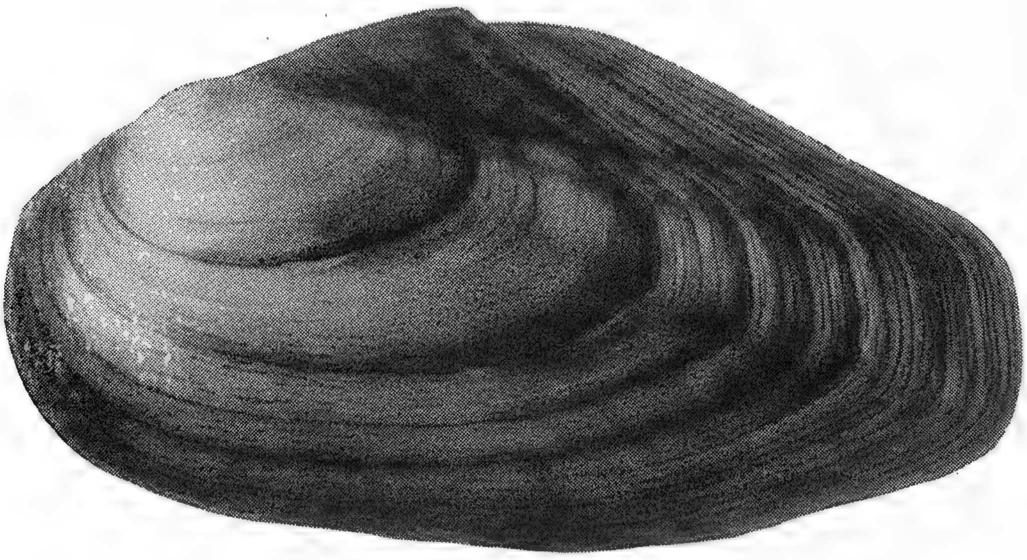
A. anatina, var. *complanata* Ziegler.



22. Rossmässler, *Icon. L.- u. S. Moll.*, f. 68*a*. × ·77.

23. Shell from Gumfreston, near Tenby. × ·65.

A. anatina, var. *rostrata* Rossmässler.



24. Rossmässler, *Icon. L.- u. S. Moll.*, f. 284. × ·66.

A. anatina, var. *subrhombea* Brown.

25. Brown, *Illust. L. & F. Conch.*, pl. 16, f. 4. × ·66.

NOTES ON ENEMIES OF MOLLUSCA.

By Lionel E. Adams.

(*Read before the Society*, 13*th November*, 1937.)

I have been very much interested in Messrs. Wild and Lawson's comprehensive list of the "Enemies of the Land and Freshwater Mollusca of the British Isles". For many years I have made notes on the subject and can confirm most of the records except those of the wild birds. *Cyclostoma elegans* may be added as a victim of mice; on two occasions I have found individuals in mouse runs gnawed round the periphery.

There are, however, two records in the list of enemies to which I must call attention :—

(1) "Bats" as devourers of *Planorbis*, *Paludina* and *Anodonta:* on looking up the reference [1] I find in J. R. B. Masefield's presidential address the statement, "Bats have even been found feeding on *Paludina*, *Planorbis* and *Anodonta* . . ." Surely, a misprint for "Rats"?

2. Again, looking up the reference to Swans eating *Anodonta*,[2] it seems that Miss Blundell, relying on the testimony of "an old groom", and having seen swans "fly away leaving behind them numbers of empty shells", avers that "Swans do eat *Anodonta cygnea* in large quantities". The conclusion drawn from the facts was in my opinion a false one. I have reason to think it was rats that ate the mussels.

Some years ago I made a number of experiments to settle the question.

Two large ponds near Reigate were frequented by tame Swans which would come to the side hoping to be fed. The ponds contained quantities of *Anodonta cygnea* and *A. anatina* which I used to pitch to the expectant birds. They would turn away with merely a glance.

At the sides of the ponds were numerous burrows of the brown rat, and the entrances to these burrows were strewn with empty gnawed shells.

I sent J. W. Taylor some of these shells characteristically gnawed along the thin edge. By the way rats, mice, and voles always attack a spiral shell round the periphery—but gnaw mussels along the thin edge. I have often seen rooks stabbing and breaking mussels but the sensitive bills of Swans are quite unsuitable for the purpose.

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[1] *Journal of Conchology*, ix, 162.
[2] *Journal of Conchology*, xi, 318.

SPHÆRIUM PALLIDUM GRAY AND SPHÆRIUM TRANSVERSUM SAY.

By A. E. Boycott and C. Oldham.

(*Read before the Society, 4th September,* 1937.)

Sphærium pallidum was described as a new species by J. E. Gray [1] in 1856 from specimens found in the Paddington Canal by J. Rouse. J. G. Jeffreys [2] identified it with the *S. ovale* of Férussac (1807), and adds the significant remark that " the species appears to have been lost in France ". It has since been known in this country under one or other of these names, was found by R. D. Darbishire [3] in the Manchester canals in 1860, and has now been authenticated for Roebuck's *Census* from Oxford, Gloucester, Northampton, Warwick, Worcester, Stafford, Shropshire, Montgomery, Cheshire, Lancashire, and Yorkshire—always in canals or highly canalized rivers in connection with the great canal system of Central England. Owing to the possibility of confusion with some forms of *S. lacustre*, unverified records which are exceptions to this rule cannot be taken very seriously: the most likely one is " Exmouth (Clark) ", specimens of which are discussed by Jeffreys and may possibly have come from the Exeter canal. The species is unknown as a fossil: Mr. Kennard tells us that the pleistocene shell recorded [4] as *pallidum* was really *S. dickinii.*

Its restriction to an artificial habitat and the absence of any geological history suggest that it is an alien. It is, however, not known in France [5] or Germany [6] and, beginning with Jeffreys,[7] several people have suspected that it came from America and might be the *Sphærium transversum* of Say. No one, however, appears to have pursued the matter so we recently sent to Dr. H. B. Baker of Philadelphia a series of characteristic examples of *S. pallidum* from canals at Ashton-under-Lyne, Lancashire (coll. F. Taylor, 1917, 1918), Elland, Yorks (coll. F. Booth, 1908), Sandbach, Cheshire (coll. C. Oldham, 1900), and Banbury, Oxon (coll. C. Oldham, 1926). He replied : " Your *Sphæriidæ* have been compared

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[1] *Am. Mag. Nat. Hist.*, 1856, vol. xvii, p. 465.
[2] *British Conchology*, 1862, vol. i, p. 8.
[3] R. Standen, *Naturalist*, 1887, p. 157; J. W. Jackson, *Journal of Conchology*, 1907, vol. xii, p. 54.
[4] A. S. Kennard and B. B. Woodward, *Proc. Geol. Assoc.*, 1917, vol. xxviii, p. 109.
[5] L. Germain, *Mollusques terrestres et fluviatiles de France*, 1931, vol. ii, p. 692.
[6] D. Geyer, *Unsere land- und süsswasser Mollusken*, 1927.
[7] *Am. Mag. Nat. Hist.*, 1869, vol. iv, p. 342.

with specimens of *Musculium transversum* (Say) from around Philadelphia, and do indeed seem to be the same species. The Philadelphia shells of similar size have somewhat longer cardinals, but they are of the same form and arrangement (examination made under magnification of about 100 diameters). Dr. Pilsbry also looked at these (under a hand lens) and considers them the same species." If this identification be accepted it seems to follow that our species should be called *S. transversum* which was described by Say in 1829.

PISIDIUM CONVENTUS IN WESTMORLAND AND CUMBERLAND.

By Chas. Oldham.

(*Read before the Society, 4th September,* 1937.)

A collection of Pisidia from the English Lake District, which Mr. T. T. Macan sent me recently, included a gathering made on 7th October, 1936, in Brown Cove Tarn, a small shallow artificial pool with a N.E. aspect at 2,300 feet on Helvellyn, some way above the now dried up Keppel Cove Tarn. This gathering comprised examples of *P. personatum* and *P. conventus.* Prompted by Mr. Macan's interesting discovery, I looked up the Lake District material I had, and found a single example of *conventus*—the sole result of an hour's intensive collecting in Grisedale Tarn, Helvellyn (1,768 feet) on 11th June, 1918—and several others collected on the same day, with *P. personatum* and—in another part of the tarn—*P. cinereum* in the Red Tarn, Helvellyn (2,356 feet). The Red Tarn is separated from Mr. Macan's locus in Brown Cove by Swirrel Edge. These Grisedale and Red Tarn shells were recognized at the time I collected them as conspecific with the little *Pisidium* that lives in tarns on Brandon Mountain, Co. Kerry, and in tarns in Snowdonia ; and which was then regarded as a depauperate form of *P. cinereum*, but now as *P. conventus.* The shells were labelled " depauperate *P. casertanum* " (i.e. *P. cinereum*) and stored with the Pisidia—some thousands in all—that I collected in the Lake District in 1918, 1919 and 1920 ; but when I reviewed the position of *P. conventus* as a British species (*Journal of Conchology*, vol. 19, pp. 274–277) and indeed until Mr. Macan's shells reached me a few weeks ago, they had escaped my memory altogether. The Helvellyn localities are all in Westmorland, but Cumberland may now be added to the known range of *P. conventus*, for examples, associated with *P. cinereum*, were collected in a small boggy pool at Grange-in-Borrowdale by Mr. H. Overton in 1917.

PISIDIUM LILLJEBORGII CLESS. IN GLAMORGAN.

By Chas. Oldham.

(*Read before the Society, 4th September,* 1937.)

On 5th June, 1937, with Professor A. E. Boycott, I visited Llyn Fawr and Llyn Fach, two corrie tarns backed by the precipices of Craig-y-Llyn, the highest land in Glamorgan, and overlooking the upper part of the Vale of Neath. The larger tarn has been made into a reservoir and in it we found no molluscs ; but, although it held no gastropod, Llyn Fach at 1,450 feet harboured in its silty bed *P. cinereum* and *P. lilljeborgii* in some abundance. Hitherto the most southerly known locality for *lilljeborgii* in Wales was Llyn Du, near Meifod in Montgomery, about 70 miles N.E. of Craig-y-Llyn (*ante*, xvi, p. 233). No suitable locus for *lilljeborgii* in Pembroke is known to me, and in Brecon, Radnor, and Carmarthen lakes and mountain tarns are less numerous than farther north, whilst such as there are have often been converted into reservoirs, a state of things that is even more prevalent in Cardigan. This implies violent and frequent changes in water-level, a condition repugnant to *lilljeborgii* and some other Pisidia. I have searched for *lilljeborgii* in all these southern counties without success, but its occurrence in Glamorgan suggests that eventually it will be found in tarns that have retained their natural state elsewhere in South Wales.

Limnæa stagnalis in dew-ponds. *L. stagnalis* is not common in downland ponds. In 1923 it was seen in one of the two ponds near the Lansdowne Monument on the top of the hill overlooking Calne (Wilts) at about 700 feet, and in 1929 or 1930 in another pond on the edge of the Wiltshire downs close to the road from Amesbury to Mere where it drops down to the Wylye valley, at about 400 feet. In neither case was it a temporary occupation for in 1937 *stagnalis* was profusely abundant in both places. In the first pond there were no other mollusca and no higher plants but a stonewort in some quantity and some algæ ; the second was well supplied with *Pot. natans* and *Myriophyllum* and also had *Limnæa peregra, Spærium lacustre,* and *Pisidium subtruncatum.*—A. E. Boycott and C. Oldham. (*Read before the Society, 4th September,* 1937.)

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN & IRELAND.

(*Continued from p.* 30.)

HON. CURATOR'S REPORT.

SINCE the last Annual Meeting the Brazier Cabinet has been thoroughly overhauled and the Brazier Collection of Australian shells has been placed in the first six drawers of the Brazier Cabinet. The specimens are now mounted in glass-topped boxes. In addition to this the Stubbs Collection of European shells has been placed in drawer 7, the Morris Collection from Lewes, etc., in drawer 8, the Stubbs Collection from Tenby, etc., in drawers 9 and 10, and the Standen Collection of Irish shells in drawer 11. In drawer 12 several small collections have been housed, including collections by A. W. Stelfox and C. S. Carter, a miscellaneous collection from Lewes, and one of shells found in Staffordshire during an excursion by the Society in 1894.

These have been arranged ready for inspection and catalogued. The Brazier Collection: In many cases interesting notes were enclosed with the specimens; these have been copied into a manuscript book and make very interesting reading. The remarks are numbered to correspond with the figures on the undersides of the boxes.

ANNUAL REPORT OF THE YORKSHIRE CONCHOLOGICAL SOCIETY.

THE present Annual Meeting is the forty-first anniversary of the Society. At the last Annual Meeting the following officers were elected :—

President: H. C. Versey, D.Sc.
Vice-Presidents: J. D. Firth and A. Smith.
Hon. Treasurer and Recorder: H. J. Armstrong.
Council: As before with J. R. Dibb.
Hon. Secretary: E. Dearing.

An increase of membership to twenty-five is an encouraging fact; three new members having been enrolled during the year.

Ten meetings have been held this session, with an average attendance of 8·1.

In November a joint meeting with the Conchological Society of Great Britain and Ireland was held in Leeds, and Mr. Spence of the parent Society presented a paper. In December the exhibit meeting was held in Great George Street.

From the New Year we have been installed in Geology House, and in January a series of short papers and of special exhibits of Operculate Land Molluscs was presented.

The February meeting, the Presidential one, was well attended, and members were very kindly entertained to tea after the meeting by Dr. and Mrs. Versey.

Mr. Allen renewed his acquaintance with us in March on the topic of Freshwater Molluscs, a paper which led to a most interesting discussion.

The Spring Joint Meeting was at Manchester Museum in April.

Four excursions have taken place during the summer months. Huddersfield was visited under the leadership of Mr. North, who very kindly entertained the party to tea at his home. The next ramble was to Brotherton, on 12th June, a joint meeting with the Y.N.U. Conchological Section. Another joint meeting with the Barnsley Naturalist and Scientific Society and the South-West Yorkshire Entomological Society was to Secker Vale,

instead of the proposed one to Ryhill. The last excursion was to Bramham Crossroads, led by Mr. Armstrong. Drought spoiled the collecting on this occasion.

There are still three meetings to complete the syllabus.

E. DEARING, *Hon. Secretary.*

ANNUAL REPORT OF THE LONDON BRANCH.

NINE meetings have been held, with a good average attendance at each.

A comprehensive syllabus has been worked through as printed, a feature of this syllabus being the continuation of notes upon the Mollusca of isolated places. Thus at the May meeting the President, Mr. A. S. Kennard, (who continued in the chair), read notes upon " Shells of Lake Baikal "; and in April Col. Peile dealt with " Land Shells of the Seychelles ".

Other interesting items were " British and Exotic Pectens ", " Rare Land Shells," "*Patella vulgata, athletica* and *depressa*," "*Corilla*," " Dentaliidæ," and at the last meeting " Cameos ", with which subject Mr. A. Blok showed himself to be very conversant, taking the members right through the process of making cameos from the actual shell to the finished article, showing among his exhibits the actual tools used in carving these cameos. Altogether a very successful year.

At the June meeting suggestions were made for a new syllabus, which is now in circulation, and an equally good year is confidently anticipated.

G. L. WILKINS, *Hon. Secretary.*

ANNUAL REPORT OF THE NORTH STAFFORDSHIRE BRANCH.

DURING the past season our members have done field work on many occasions, singly and collectively, but nothing of outstanding interest has turned up. The apparent scarcity of shells during the greater part of the year is presumably due to the dry conditions. Coupled with this, of course, there is the continued gradual destruction of habitats, as a result of housing and road development.

Dr. W. E. Alkins has again been elected President of the Branch for 1938.

B. BRYAN, *Hon. Secretary.*

646th Meeting (Joint Meeting with the Yorkshire Conchological Society), held at Leeds University, 13th November, 1937.

Dr. H. C. Versey, President of the Yorkshire Society, in the chair.

Members present: Messrs. J. C. North, J. Digby Firth, W. Thurgood, F. Taylor, C. H. Moore, G. C. Spence, A. K. Lawson, D. Fisher, H. J. Armstrong, Mrs. Morehouse, and Dr. J. W. Jackson.

Papers Read.

" Notes on Enemies of Mollusca," by L. E. Adams.
" The British Species of *Anodonta* and their Varieties," by H. H. Bloomer.
" Note on *Nucella lapillus* L., at Knott End, Fleetwood," by C. H. Moore.

Address by the President.

Dr. Versey gave a short address entitled " Some Notes on Protobranch Molluscs ", which was listened to with great interest.

Exhibits.

By Dr. H. C. Versey: Specimens to illustrate his address; also "Mélanges: Paul Pelseneer".

By Mrs. Morehouse: Large *Bithynia tentaculata* and *Lymnæa glabra*, also malformed *Lymnæa pereger* and *Planorbis spirorbis*, and many others.

By Mr. H. J. Armstrong: Shell curios used in barter and exchange; pearl-shell fish-hooks.

By Mr. J. C. North: Shells collected locally and in the Isle of Wight.

By Mr. C. H. Moore: Shells from Llandudno.

By Mr. A. K. Lawson: Marine shells illustrating attacks by enemies.

By Mr. G. C. Spence: African land operculates.

By Dr. J. W. Jackson: *Nuculopsis gibbosa* (Flem.) from Redesdale Ironstone, Northumberland (Carboniferous Limestone), and *Nuculana attenuata* (Flem.) from Dumfries (Lower Carboniferous).

By Mr. F. Taylor: Series of shells from the canal at Droylsden, Lancs, taken this year, including some fine *Unio pictorum*, *Anodonta cygnea*, *A. anatina*, *Sphærium rivicola*; *Helix odeca* vars., with juveniles and darts, from Coombe Cellars, S. Devon; *Ashfordia granulata*, with eggs and juveniles, *Clausilia rugosa* and short tumid form, *Cochlicopa lubrica*, *Vallonia costata*, and *Cecilioides acicula*, from Bolton-le-Sands, Morecambe Bay; an interesting series of *Clausilia biplicata* with eggs, fry, albinos, repaired specimens, etc., from Purfleet, Essex; *Vallonia costata* and *Vallonia* sp., from Coulsdon, Surrey; *Helix hortensis* var. *roseozonata*, from the same locality; *Helix hortensis*, scalariform, from Kirkcudbright (coll. Chas. Oppenheimer, October, 1937); and many others.

647th Meeting, held at the Manchester Museum, 4th December, 1937.

Mr. C. H. Moore in the chair.

Member Deceased.

Henry Crowther, the last of the four Founders of the Society.

Member Resigned.

H. R. Wakefield.

Candidate Proposed for Membership.

W. Thurgood, 16 Moss Gardens, Alwoodley, Leeds (introduced by J. W. Jackson and C. H. Moore).

Paper Read.

"Nudibranch Nomenclature," by Miss K. White (read in title).

Exhibits.

By Mr. L. E. Adams: Caddis cases made of shells from various localities.

By Mrs. N. McMillan: *Phytia myosotis* (Drap.) from Belan Fort, Carnarvonshire: *Potamopyrgus jenkinsi* (Sm.) from Llyn Coron, Anglesey; Malldraeth, Anglesey; and Rake Lane, Cheshire.

By Mr. C. H. Moore: *Helicella virgata* and *H. caperata* from Fleetwood.

648th Meeting, held at the Manchester Museum, 8th January, 1938.

Mr. G. C. Spence in the chair.

Member Elected.

W. Thurgood.

Candidate Proposed for Membership.

John Adams Pringle, M.Sc., Museum, Port Elizabeth, South Africa (introduced by Keppel H. Barnard and M. Milman).

Member Deceased.

R. A. Adkin.

Exhibits.

By the Rev. Canon L. W. Grensted: *Crepidula fornicata* L. from Bournemouth.

By Mr. G. C. Spence: Chank-shell trumpet and chank-shell ear-ring; also shells of *Achatina* showing differences in size in the same species.

By Mr. C. H. Moore: A specimen of *Narica cancellata* Lam.

By Mr. F. Taylor: Freshwater shells from the canal at Droylsden, Lancashire, including *Lymnæa stagnalis* and var. *picta*, and *Planorbis corneus*; also large specimens of *Sphærium rivicola* from the canal at Waterhouses, Lancashire.

The special exhibit was *Marginella*.

649th Meeting, held at the Manchester Museum, 12th February, 1938.

Mr. G. C. Spence in the chair.

Member Elected.

J. A. Pringle.

Member Deceased.

Alfred Hartley.

Paper Read.

"Obituary Notice of Miss Amy Warren," by Mrs. N. McMillan.

Exhibits.

By Mr. R. Macdonald: *Potamopyrgus jenkinsi* var. *carinata* from the Belfast Waterworks.

By Mrs. Morehouse: *Tricolia pullus* L. from Porthcurnow (dead) and Penzance (alive).

By Dr. J. W. Jackson: A large series of *Nucella lapillus* from Pembrokeshire and other places (Lloyd James and R. D. Darbishire collections, Manchester Museum).

The Special Exhibit was British Non-Marine Operculates.

650th Meeting, held at the Manchester Museum, 12th March, 1938.

Mr. G. C. Spence in the chair.

Member Deceased.

Rev. T. P. Levett.

Exhibits.

By Mr. A. K. Lawson: *Helix aspersa* var. from Llandudno; *Strombus isabella* Lam. from Philippine Is.

By Mr. F. Taylor: *Vertigo lilljeborgi* and *Amnicola taylori* from North Britain (Waterston coll.).

The Special Exhibit was *Clausilia*, especially British.

Malacological Society of London.

Hon. Sec.: G. I. CRAWFORD, M.A., Brit. Mus. Nat. Hist., Cromwell Road, S.W.7.

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THE
JOURNAL OF CONCHOLOGY.

VOL. 21. 22nd SEPTEMBER, 1938. No. 3

MISS AMY WARREN (*circa* 1840–1932).

By NORA FISHER McMILLAN.

(*Read before the Society, 12th February*, 1938.)

THE name of Amy Warren is almost unknown to present-day conchologists, but she was a member of the Conchological Society from 1890 until 1897, and did a great deal of collecting in Mayo and Sligo.

Her full name was Amelia Elizabeth Mary Warren, and she was born about 1840, the daughter of Robert Warren, of Castle Warren, Co. Cork, and his wife Matilda, youngest daughter of a Cork merchant, Edward H. Hopper. There were three other children, Robert Warren the ornithologist being the eldest. In 1851 the Warrens moved from Co. Cork to Moy View, Ballina, Sligo, and carried on farming there until 1909, when the establishment was moved to Cork once more, where Miss Warren spent her later years. She died in February, 1932, aged about 92.

Miss Warren became interested in shells when in Ballina, and collected extensively in the counties of Mayo and Sligo. She did not publish a great deal; a list of her papers is given at the end of this notice. Her collection of shells was left to a friend, Mrs. H. F. Tivy, who presented it to the National Museum, Dublin.

For most of the particulars of the above brief account I am indebted to Mr. H. F. Tivy, a personal friend of Miss Warren.

LIST OF PAPERS.

"The Land and Freshwater Mollusca of Mayo and Sligo." *Zool.* (3), iii, 25–9, 1879.
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"Sea-birds in Co. Sligo." *Irish Nat.*, i, 171, 1892.

ARTHUR EDWIN BOYCOTT, D.M., F.R.S. (1877–1938).

By Charles Oldham.

Plate 10.

Arthur Edwin Boycott was born 6th April, 1877, at Hereford, where his father practised as a solicitor. From the Cathedral school there he went with an open classical scholarship to Oriel College, Oxford. He won several university scholarships and in 1903, after obtaining his doctorate in medicine, was elected Fellow of Brasenose. He was also M.A., F.R.C.P., and Hon. LL.D. of McGill University, Montreal, and in 1914 was elected Fellow of the Royal Society. In 1904 he married Constance, daughter of Colonel Agg, of Hewletts, Gloucestershire, who with two sons survives him. His early married life was spent at Carshalton and Banstead, and in 1912 he went to Manchester as Professor of Pathology in the University. In 1915 he came south again on being appointed Graham Professor of Pathology at University College Hospital Medical School, and lived at Radlett, in Hertfordshire, until 1934, when ill-health compelled him to retire from active professional work, and from 1935 he lived at Ewen, near Cirencester. Although not robust he never spared himself, and his ardent spirit often outran his physical capabilities. Even in 1934, when he developed tubercular trouble, and thereafter until the end, he still used his physical resources to the uttermost. The benefit he obtained from spending the winter of 1934–5 in a Norfolk sanatorium was only temporary, and during the last three years of his life, with his intellectual powers unimpaired, he was fighting a losing battle, and for the last seven months was confined to his bed. When they went to his room on the morning of 12th May, the long fight, waged with so much courage and patience against overwhelming odds, was over, for death had come to him in his sleep.

The story of Boycott's distinguished career as a pathologist has been told elsewhere [1]; we are concerned here with his contributions to the science of Conchology. These were restricted virtually to the British land and freshwater species, but within these limits his interest was deep and many-sided, and his erudition profound.

Boycott joined our Society in 1897, and from the first evinced a lively interest in its well-being. He was President in 1916–18,

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[1] *Times*, 18th May, 1938; *Lancet*, 21st May, 1938; *Brit. Med. Journ.*, 21st May, 1938; *Nature*, 2nd July, 1938; *Journal of Pathology and Bacteriology*, xlvii, 1938.

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A. E. Boycott (1925).

Facing p. 58.

and his wisdom and tact have often been of service in the direction of its affairs. For nearly forty years he was a frequent contributor to the *Journal of Conchology*. In 1921 he brought up to date and practically re-wrote the *Census of the Distribution of British Land and Freshwater Mollusca.* Until his death he acted as Recorder for the Census, and made reports annually on recent additions. Although he always referred to it as " Roebuck's Census ", it is in its present form and scope his work ; it constitutes perhaps a more complete account of distribution in this country than exists for any other of the main groups of animals.

In *Who's Who* Boycott's recreations are defined as " the country " and "snails", a description apt enough from his school days onwards. In 1892, when only 15, he wrote in *Hardwicke's Science Gossip* " Contributions towards a list of the Mollusca of Hereford ". Later, in collaboration with his friend, E. W. W. Bowell, he contributed a paper with a similar title to the *Transactions of the Woolhope Naturalists' Field Club.* This paper, of 104 pages, was not a mere list of species ; it gave much information on habits and habitats, dimensions and variation in form and colouration, an earnest of the investigations of later years. His last paper, " Experiments on the artificial breeding of *Limnæa involuta*, *Limnæa burnetti*, and other forms of *Limnæa peregra*," the record of ten years' work, was finished only a few days before his death. His great and varied output in the interim will have a lasting effect on conchological studies.

His anatomical researches cleared up obscure points in the structure and function of many species, e.g. *Hyalinia helvetica*, *Zonitoides excavatus*, *Helicella heripensis*, *H. neglecta*, *Helicodonta obvoluta*,[2] *Acanthinula aculeata*, *A. lamellata*, *Theba cantiana*, *Cochlicopa lubrica*, *Azeca tridens*, *Pomatias elegans*, and *Limnæa peregra*, established *Vitrina major* as a British species, and demonstrated the parthenogenetic character of *Paludestrina jenkinsi.*

Nearly twenty years ago Boycott became interested in the inheritance of sinistrality in *Limnæa peregra*, and from 1920 to 1930, in collaboration with others and with the assistance of a band of willing helpers, he conducted a vast experiment which involved some six thousand broods and approximately a million snails. Some preliminary papers and the final summary in the *Philosophical Transactions of the Royal Society* are an important contribution to the science of Genetics. The question of the inheritance of involute and other unusual forms of *Limnæa peregra* which cropped up in the course of this huge investigation, was the

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[2] *Vide* J. W. Taylor, *Monog. Brit. Land and Freshwater Moll.*, iv, p. 53.

subject of another big experiment in the decade 1928–38, the results of which were summarized in his last paper. He experimented too on the inheritance of shell ornament in *Paludestrina jenkinsi.*

Variation in the size, form, and colouration of shells always interested him, and some of his earlier papers were devoted to this subject. Among later papers one dealt with size variation in *Clausilia bidentata* and *Ena obscura* within a " locality ". A Presidential Address to this Society dealt with the local variation of *Clausilia bidentata*, and in a Presidential Address to the Malacological Society he discussed the technique of " Conchometry ".

The mere fact that a snail is or is not in this place or that is the initial step in the much larger question—why is it here and not there, and, having got here, how is it able to establish itself? These considerations connote the passage from the part to the whole, from Geographical Distribution to Ecology, that is to the relation of the snail to its environment, using that term in its widest sense. Boycott used to say that properly to understand how a snail lives one must try to look at the world from the snail's point of view, and it was undoubtedly the ecological aspect of Conchology that interested him most in his later years. Papers on the snails of Nevin, Langdale, the Scottish Highlands, and South-West Ireland abound in ecological data, as do those that deal with the strikingly different faunas of canals that connect with the great plexus of waterways in Central England, when compared with the faunas of those outside it. Presidential Addresses to the Hertfordshire Natural History Society, the Malacological Society, and the Conchological Society dealt respectively with the Freshwater Mollusca of Aldenham—this was supplemented by another paper ten years afterwards—the Œcology of British Land Mollusca, with special reference to those of ill-defined habitats, and the Habitats of Freshwater Mollusca. Two exhaustive papers on the Habitats of Land and Freshwater Mollusca in Britain, based upon a Presidential Address to the British Ecological Society in 1933, represent the field work of a lifetime, coupled with very wide reading. They are models of conciseness, replete with relevant matter, and fine examples of the writer's scholarly and lucid style. For years to come they will be a sure foundation for any ecological work on British snails.

Boycott was interested in snails themselves rather than in their names, and strict adherents to the Law of Priority were apt to look upon him as a rebel, but in a recent note he did advocate the use of the name *transversum* for the bivalve that was known in this country as *Sphærium ovale* and later as *S. pallidum*.

Among many papers and short notes the following may be cited as examples of the writer's versatility : " Occurrence of the larva of a Cestode Worm in *Polita rogersi* " ; " A specimen of *Limnæa pereger* coiled on the flat " ; " A contagious disease of *Helix aspersa* " ; " Dextral specimen of *Clausilia bidentata* " ; " The History of *Helix hortensis* and *Helicella caperata* at Aberdeen " ; " *Vertigo alpestris* var. *albina* in Westmorland " ; " Development of the colour of *Arion ater* " ; " Food of *Geomalacus maculosus* " ; " Survival of *Helicella virgata* through the winter " ; " *Ena montana* at Lackham " ; " ' Helix Tor ' and ' Snaily House ' " ; " Habits of young *Helix pomatia* " ; and " Tolerance of hard water by *Margaritana margaritifera* ".

Boycott was a connoisseur in scenery and would often stop at a gate or some other vantage point that commanded a fine view ; but to him a landscape meant something more than a mere contentment to the eye. He had always in mind the various potent factors that had gone to the making of the picture, ice and water, the nature of the rocks and their characteristic way of weathering, the prevailing wind, the age, nature, and extent of the woodlands, and so on ; and the suitability of varying kinds of country as habitats for snails and other creatures was surely in his thoughts. His study of molluscan habitats took him to many delectable places, with characters as diverse as the bleak austerities of the Cairngorms, the stark open spaces of Bodmin Moor and Dartmoor, the golden sand-dunes of Somerset and Donegal, the unspoiled rustic comeliness of Shropshire and the Welsh Marches, the rolling downs and beechen coombes of the Chilterns, the country of the White Horse and the South Downs, the remoter parts of Brecon and Radnor, the softer beauties of Branscombe—where so many holidays were spent—and the incomparable loveliness of the Cork and Kerry mountains. It was fitting that when he died his ashes were scattered to the four winds at Roel Gate in the Cotswolds that he loved so well.

Hunting for snails sometimes leads to queer situations. One day Boycott was grubbing in the leaves at the base of a stone wall not far from the prison on Dartmoor. Some slight movement made him look up, to find that he was covered by the rifle of an altogether unsympathetic warder. There was another story associated with a stone wall. In County Donegal some years ago, when the state of the country was less settled than it is now, Boycott was searching at the base of a 5 ft. wall on the side remote from the road whilst his companion was similarly engaged on the roadside 50 yards away. Just as a man driving a motor car along the road came level with the place where, unknown to him, Boycott was, a lean face popped up above the top of the wall. The motorist, not without

reason, suspected a trap, jumped from the car, threw up his hands and exclaimed, " What's the matter ; is anything wrong ? " A puzzled look and the reply, " No, I am only looking for snails," exceeded his worst suspicions. Thinking that not only was he ambushed but ambushed by two lunatics he shouted, " Good God ! ", dashed for the car and, regardless of the risk he ran, drove off at full speed.

Most of Boycott's snail-hunting expeditions were, until recently, made on foot or bicycle, but during the last few years he availed himself of the convenience of a motor car for getting from place to place and accommodating quantities of gear. His motoring often puzzled other users of the road. He would set out for a week's jaunt, the car packed to repletion with dredges, nets and scoops, poles, rakes and rods, wading-boots, sacks and bags of different kinds, many—but seldom sufficient—bottles for water samples, and larger jars and canisters for water of varying degrees of hardness to be used in experiments at home. Then there was a piece of gear that served indifferently for boiling water for tea or cooking mussels and the larger snails during a halt. On the homeward journey there were in addition bags of litter, samples of rocks, canisters of weed, and extra bottles for water samples acquired during the trip ; and if his companion for the time being was a big man it was sometimes difficult to fit him in. But motoring was no affair of noisy haste. He used to say—half in jest—that only very exceptional circumstances could warrant a motorist in driving at a pace that made him incapable of identifying any butterfly he encountered, and more seriously, perhaps, that he could wish for no better epitaph than, " He never overtook a car." These are trifling things, perhaps, but indicative of his independence and disregard of the lesser conventions.

In Boycott a handsome presence and great personal charm were associated with an alert, eager, and penetrating mind, quick to discern and disentangle the essentials of any problem and apt in its solution. His critical faculty was essentially constructive, and in whatever he did he was valiant—sometimes almost quixotic in his advocacy—for the truth as he saw it, implacable where any principle was involved and intolerant of shams or slipshod work. His knowledge, the outcome of unflagging industry, extensive work in the field and laboratory, and wide reading, was always at the disposal of others ; and there is perhaps no one who during the past twenty years has been really interested in any way in our British snails who has not benefited by his advice, suggestion, and practical help. His death means a gap in the lives of those who knew and loved him, and his memory will long be held in respect and admira-

tion by members of a wider public, to many of whom, unknown to him personally, his published works and his letters of advice and encouragement, expressed with great clarity and a Stevensonian nicety in the choice of words, written in a characteristic small, neat hand, and—as his conversation was too—often graced by a certain whimsical humour, have been a help and a stimulus to further effort.

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[This has no claim to be exhaustive, but it includes most, at any rate, of Boycott's more important contributions to Conchological literature. An asterisk before any title implies collaboration.]

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Experiments on the artificial breeding of *Limnæa involuta*, *Limnæa burnetti*, and other forms of *Limnæa peregra*. Ibid.

Operculum of Turbo pulcher Reeve.—My friend, Mr. J. R. le B. Tomlin, has published a note on *Turbo intercostalis* (*Proc. Mal. Soc.* (*Lond.*), vol. xxii, p. 137, Nov., 1936), in which he suggests that for the first time this is shown to be the correct name of *Turbo pulcher* Reeve. I would not have commented on this, as I had some years previously (*Mem. Queensland Mus.*, vol. ix, p. 273, 29th June, 1929) published the same conclusions, but that Tomlin stated that the opercula in the shells were not authentic, being those of *Sarmaticus*, whereas this shell was conchologically a *Senectus*. However, the operculum is correct as Sowerby (*Proc. Mal. Soc.* (*Lond.*), vol. v, p. 12, 1902) had pointed out, and many specimens here confirm this. I merely noted this development in my latest notes (*Austr. Zool.*, vol. viii, pp. 247–8, 12th March, 1937), and I had proposed to designate this fact by a new subgeneric name, but withheld it. I now introduce the new subgeneric name Varostium for *Turbo pulcher* = *intercostalis* Menke, whose shell is similar to that of *Senectus*, i.e. Turbinid with strong concentric liræ and radial striæ, whorls rounded, umbilicus minute, the operculum suboval, the nucleus circular but developing a little eccentrically, the outer surface with strong erect packed granules, diminishing in size towards the edges.—Tom Iredale.

Clanculus howinsulæ Salisbury.—This name has been given to the common little Lord Howe Island *Clanculus* by Salisbury (*Proc. Mal. Soc.* (*Lond.*), vol. xxii, p. 125, pl. 13*a*, figs., Nov., 1936), but it might have been wondered why such a well-known shell had not received a name before. Salisbury contrasted it with *bertholeti* (*sic*) Orbigny and *dunkeri* Philippi, neither of which resemble it closely, but he overlooked *thomasi* Crosse (*Journ. de Conch.*, vol. x, p. 405, pl. 13, fig. 4, 1st Oct., 1862), from New Caledonia, from which it is with difficulty only distinguished. Hedley had so named it, and recently working over Lord Howe shells I noted that the Lord Howe Island shell was generally a little larger, the granulation of the ribs a little more prominent, the colouration darker, but that no specific distinction was possible. The size factor became valueless when it was noted that dredged specimens, although adult, were smaller than the New Caledonian specimens.—Tom Iredale.

W. H. TURTON (1856–1938).

By THE EDITOR.

WILLIAM HARRY TURTON was born in India in 1856, the second son of Colonel Joseph Turton, R.A. His father died of wounds received in the Mutiny on a voyage home from India and was buried in the Red Sea.

He had a brilliant school career at Clifton, winning the geographical gold medal among other distinctions; thence he passed into the "Shop" at Woolwich, won the Pollock gold medal, and eventually passed out first into the Royal Engineers.

From 1884 to 1886 he was stationed in St. Helena and it was during this time that we first hear of him as a conchologist. He brought home an extensive collection of shells, both marine [1] and terrestrial,[2] which was worked out by Edgar Smith, and contained a very large number of new species. The land shells included eleven undescribed forms and constituted a very adequate representation of both the living and the extinct species.

In his marine collecting Turton was indefatigable in sifting the sand and shingle which is found in but a few spots on the coast, and he also dredged in depths up to about 80 fathoms.

His collection is probably a fairly complete one of the fauna—including as it does such a large percentage of small forms as *Rissoidæ*, *Rissoinidæ*, small *Turridæ*, and *Pyramidellidæ*. The types are all in the British Museum.

Turton went all through the Boer War in South Africa and there gained his D.S.O. His service out there introduced him, of course, to the Cape marine molluscan fauna, and his retirement with the rank of Lieut.-Colonel soon after the War, at the end of twenty-six years' work, gave him uninterrupted scope for shell collecting; he determined to make Port Alfred at the mouth of the Kowie River the centre of his researches.

He gradually evolved the idea of working a fixed stretch of beach and of trying to record from it a larger number of species than had ever been taken from such a locus before.

He therefore mapped out a 10 mile line from the Kasouga River on the west of Port Alfred to the West Kleinmond River on the east, constituting about 11 miles of beach, as very fully explained in the preface of his *Marine Shells of Port Alfred*.

In 1935 Turton's health completely broke down and he was obliged to leave Clifton, Bristol. After a year at Minehead he moved

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[1] *P.Z.S.*, 1890, pp. 247–317, pls. xxi-xxiv. *Ann. Mag. N.H.* (6), vol. 10, pp. 121–135, pl. xii, 1892.

[2] *P.Z.S.*, 1892, pp. 258–270, pls. xxi, xxii.

again to a small house that he had bought at Northlew, Devon, early this year, and died there on 16th June.

Turton used to say that he had three hobbies to which, after his retirement from the army, he tried to devote an equal portion of each year, viz. Genealogy, Conchology, and Christianity.

In the last subject he is widely known as the author of *The Truth of Christianity*, which has been translated into a great number of languages including Chinese, Japanese, and Arabic, and of which he was contemplating the issue of a thirteenth edition at the time of his death.

He was a well-known member of the Genealogical Society and here again he published a *magnum opus*, just ten years ago, entitled *The Plantagenet Ancestry*. *The Times Literary Supplement* of 2nd August, 1928, said: " Colonel Turton makes use of an ingenious system of semicircles for dealing with the first five or six generations of the ancestors of a given person. This greatly economizes space in comparison with the ordinary method of displaying an ascending pedigree. Colonel Turton's list of ancestors contains a fine and varied selection of picturesque and powerful persons, famous saints and notorious sinners." Altogether over 7,000 ancestors of Edward IV and his wife are given.

In Conchology I have already referred to his excellent work in St. Helena. Otherwise his energies were almost entirely concentrated on the shells of Port Alfred, which he visited first in 1902 and subsequently on five occasions.

The 1902 gatherings were confided to Edgar Smith for naming and describing, and the results appeared in the *Journal of Malacology*, vol. xi, pp. 21–44, plates ii and iii, 1904. In such gatherings there is always a residue of young or beach-rolled specimens which cannot be named with any certainty: Turton thought that more might have been named, and the friction which had already occurred years ago over the St. Helena collection became acute.

The next collections were, therefore, offered to the Washington Museum and ten years later, in 1915, appeared *Bull. U.S. Nat. Mus.* 91, under the title of " Report on the Turton Collection of South African Marine Mollusks with Additional Notes on other South African Shells contained in the U.S. Nat. Museum ".

The idea of a record number of species from his marked-out beach became more and more of an obsession as time went on, and eventually Turton determined, after his visit to Port Alfred in 1923–4, to describe, himself, everything that remained which he considered new. His *Marine Shells of Port Alfred*, 331 pp. and 70 plates, appeared in 1932, and one cannot call it anything but a most unfortunate and deplorable piece of work. Of course each

form to which a new name is therein given will have to be judged on its merits, but one cannot help surmising that only a small percentage of the supposed novelties will survive careful scrutiny. So far the only groups that have undergone this scrutiny are the *Chitons* and the *Patellas*, with the result that in neither is a single one of the "new" species and varieties considered to have any claim to stand.

One rather curious point about this book may be mentioned; it was published towards the end of 1932—the preface is dated November, 1932, and my copy is dated Christmas, 1932, by the author—but on 14th February, 1933, Turton published a leaflet containing (1) a number of errata, (2) twenty new specific or varietal names to replace as many in his book which proved to be preoccupied. It seems as if this leaflet can only be regarded as a 2nd edition.

It has been so regarded in the *Zoological Record*, vol. lxx (1933), Mollusca, p. 39. A list of the preoccupied names and of the new substitutes was also inserted later in the same year in this *Journal*, vol. xix, pp. 370, 371, and constitutes, I believe, the only paper that Turton ever contributed to any of the conchological serials.

The book itself was printed by the Oxford University Press at a cost of about £650. The photographic plates are decidedly good.

Turton was a great-nephew of Dr. William Turton, well known for his *Conchological Dictionary*, *Manual of the Land and Freshwater Shells of the British Isles*, and other conchological works.

HENRY CROWTHER (1848–1937).

By The Editor.

By the death of Henry Crowther on 29th November, 1937, our Society loses the last of its original members, and the letter O disappears from our List. Details of his share in the foundation of the Society are to be found in vol. xviii of this Journal in Dr. Jackson's invaluable " History of the Conchological Society ", pp. 65–70.

Born at Leeds in 1848, he was educated at King's Grammar School, Pontefract, became assistant secretary to the Leeds Philosophical and Literary Society at the age of 23, and in 1876 assistant curator to their museum, which eventually was purchased by the Corporation to become the nucleus of the present City Museum.

In 1881 he was appointed curator of the Museum of the Royal Institution of Cornwall at Truro and a teacher at the Camborne Mining School, at Chacewater and Truro. In 1893 he returned to Leeds to become curator of the Philosophical and Literary Society's Museum, and in 1921, when it passed under municipal control, he was the first curator under the new régime. He retired at the age of 80, his services being retained in an advisory capacity, and in 1930 Leeds University awarded him the degree of M.Sc. (honoris causa).

In 1901, in conjunction with the head masters of Leeds schools, he initiated a scheme by which school parties heard lectures at the Museum and were then taken round to see specially selected and labelled specimens.

He was well known as a lecturer in the North and Midlands, and until his death wrote attractive nature articles weekly in the *Yorkshire Evening Post.*

He did first-class work for the mining industry by his photographic and microscopical work on early coal dust explosions, in conjunction with Sir William Garforth at Altofts Colliery; his report on these experiments was adopted by the Home Office and formed the basis of entirely new regulations.

He leaves three daughters, one of whom is now in charge of Abbey House, Kirkstall, where the collection of Bygones formed by Crowther is now housed.

He was President of this Society in 1924–5, and connected with many other scientific bodies: his Presidential Address, entitled " Some Conchological Byways ", is to be found in this Journal, vol. xviii, pp. 39–43.

A Leeds man who knew him well has described him to me as " a very kindly old boy with an encyclopædic knowledge of the museum collections : he had never tasted alcohol or smoked ".

He wrote very little on Conchology : the following is a list of his contributions to this Journal :—

Vol. i, p. 215. *Ancylus fluviatilis* var. *gibbosa* Bgt. in Yorks.

Vol. i, p. 215. *Zonites glaber* Studer near Leeds.

Vol. iv, p. 417. Biology of *Sphærium corneum* L.

Vol. viii, p. 161. Protective Resemblance of Shell of *Helix cantiana* Mont. to its Surroundings.

Vol. viii, p. 230. Mucous tracks of *Limnæa stagnalis* L.

Vol. xviii, p. 39. Some Conchological Byways.

Onychoteuthis banksii Leach at Hastings.—Several specimens of this uncommon cephalopod were washed up on the shingle at Hastings in early May, 1938. One found opposite Hastings castle on 3rd May showed a fine display by the chromatophores for nearly five hours after death ; in the second, washed ashore about a mile to the west on the following day, said to have been alive when found, no such display was noted two hours afterwards.

Both specimens brought to the Hastings Museum were measured (in inches) :—

	3rd May.	*4th May*
Body : max. width	3	2·37
Body : max. length	12·25	11
Head : max. width	2·37	2
Head : max. length	2·12	2
Tentacles : max. length	5·25	4·75
Tentacular arms (extended)	8·25	8·37
Tail fin : across	4·75	4·25
Tail fin : length	6·75	6·25
Total length to end of extended tentacular arms	22	21

Several other examples answering its description were reported about the same time, but none since.—J. MANWARING BAINES.

SOME CHARACTERISTICS OF BULINUS AND PHYSOPSIS.

By F. G. Cawston.

(*Read before the Society, 4th September*, 1937.)

Species of *Bulinus* are notoriously polymorphic and this may explain the large number of species which have been described.

An example of this may be seen in the shells of *Bulinus truncatus* Aud., the intermediate host of *Schistosomum hæmatobium* Bilharz in Iraq, which present a considerable degree of variation including typical forms of *B. contortus*, *dybowskii*, and *innesi*, and even suggesting *schackoi*.

Annandale, Baylis and Connolly place all later names in the synonym *truncatus*.

A similar variation has been noted in the shells of *Bulinus tropicus* (Krauss) in South Africa and, while some have resembled *schackoi* Jickeli, others have been described as *verreauxi*, *craveni*, and other species which may well be regarded as varieties of the same species.

To investigate these varieties I have obtained examples of *Bulinus* from the Mooi River in Natal and reared a fair supply of immature shells. In the artificial environment of a private garden no variation was observable and mosquito-breeding at the Natal coast rendered truly natural conditions impossible.

Physopsis africana Krauss is far less variable than species of *Bulinus*. Krauss described the shell as distinct from *Bulinus* because it is imperforate and because of its truncate columella. Pilsbry and Bequaert have noted that the columella is very short, its truncation deep, and relatively blunt. It is surely this columella which differentiates the species from allied shells. The shell can easily be supported on a pin passed into the channel formed by the columella. It is easily identified and efforts should be made to prevent its breeding in the many localities where it serves as a carrier of larval schistosomes of man and stock.

The shell is stated to be from 13 to 17 mm. in length, but I have often collected examples 20 mm. in length among water-lilies where the shells are not readily washed away.

The animal does not adhere firmly to floating vegetation and is easily dropped off when a leaf is raised from the surface of a pool. This is partly due to the columella and accounts for many being washed down-stream during the rains. Like other *Lymnæidæ* *Physopsis* serves as a food for domestic duck and other birds, unlike *Melanoides* whose stout operculated shell ducks cannot be persuaded to swallow.

References.

Connolly, M. (1925). "The non-marine mollusca of Portuguese East Africa," *Trans. Roy. Soc. S. Afr.*, vol. xii, part 3.

Mills, E. A., Machattie, C., and Chadwick, C. R. (1936). "*Schistosomum hæmatobium* and its life-cycle in Iraq," *Trans. Roy. Soc. Trop. Med. and Hyg.*, vol. xxx, no. 3, Nov.

Pilsbry, H. A., and Bequaert, J. (1927). "The Aquatic Molluscs of the Belgian Congo," *Bulletin of Amer. Mus. of Nat. History.*

Limicolaria as a Pest.—Damage caused to rubber plantations in Jamaica, Ceylon, etc., by various molluscs has been recorded by G. C. Robson.[1] Miss Jutting, writing on *Achatina fulica* Fér. in the Netherland East Indies, remarks that in its native country this snail "does not require special attention as a devastator, whereas in its new settlements it soon becomes an extraordinary plague".[2] Complaints are now arising with regard to damage caused by *Limicolaria* (*zebra* Pils. and *numidica* (Rve.)) on their native heath, as they are beginning to be a pest on certain palm oil plantations in the British Cameroons. They are swarming in the plantations and are giving their attention, at present, to the leguminous cover crop—*Calopogonium*, *Centrosema*, and *Pueraria*—which is interplanted with the palms. Further some of the snails have been observed feeding on the palm fruit itself.—G. C. Spence.

Helix pisana Müller.—This well-known European species in addition to circum-Mediterranean lands where it might reasonably be expected to occur has been recorded from Somaliland, Natal, and Cape Colony, in which last locality it seems to have been a highly successful settler. It has now extended its range to Western Australia where early this year living examples were taken by Mrs. J. M. Clark from a tree near the War Memorial in the National Park, Perth.—G. C. Spence.

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[1] This Journal, xiv, 225.
[2] This Journal, xx, 43.

NEW MALAY LAND SHELLS.

By J. R. le B. Tomlin.

Plate 11.

The shells described in the following paper were all received from Mr. M. W. F. Tweedie of the Raffles Museum, Singapore.

Rhiostoma chupingense n.sp. Pl. 11, figs. 1, 2.

This very fine species is a welcome addition to the group of those which show an extensively solute last whorl, such as *housei* Haines, *dalyi* Blanford, *jalorensis* Sykes and *samuiense* Tomlin. From all these, however, except the last it is at once distinguished by the absence of a tube.

R. samuiense agrees with this new species in having no tube other than a rudimentary projection on the upper margin of the peristome, but is otherwise very different—in size, build and aperture.

R. chupingense may be described as follows: whorls five, the last one bent noticeably downwards out of the plane of the earlier whorls, the rest of the shell flattish with spire slightly raised, widely umbilicate, sutures well marked; shell smooth but for regular growth-lines; colour (of holotype) light brown with a sharply defined subperipheral band of darker brown about $\frac{1}{2}$ mm. in width; aperture circular, peristome in adult moderately thickened and splayed out, operculum of the normal *Rhiostoma* type.

Diam. max. (including the disconnected whorl), 25 mm.; alt., 9 mm.

Diameter of aperture 8 mm.

Habitat: Bukit Chuping, Perlis, March, 1936.

The colour of this species is variable; one example in the type lot is bandless and a very pale yellowish; another is very dark brown through which the band shows faintly.

Opisthostoma retrovertens n.sp. Pl. 11, fig. 3.

Shell dextral, regularly conical until the last whorl, which mounts one side of the cone until in the adult the upper margin of the peristome is exactly level with the apex of the shell; number of whorls six, apex rather blunt; aperture almost circular, facing backwards vertically in a position the reverse of a normal aperture; peristome duplex; there is no spiral sculpture, but the whorls other than the smooth protoconch have prominent, thin, rather distant, retractive axial costulations; the protoconch consists apparently of one whorl, and the costulations though few on the

second whorl are distinctly traceable; sutures deep; umbilicus oval in shape and rather deep, not covered by the deviating whorl.

The specimens are all dead and no operculum is obtainable.

Diam. max., 2·4 mm.; alt., 2·5 mm.

Habitat: Bukit Chintamani, Pahang.

Several of the Bornean species of *Opisthostoma* somewhat resemble this one, e.g. *otostoma* Boettger, but *retrovertens* may at once be distinguished by the ascent of the deviating last whorl to the apex.

Diplommatina (*Sinica*) *siputana* n.sp. Pl. 11, fig. 5.

Shell minute, dextral, obtusely conical, whitish yellow, minutely rimate; number of whorls $6\frac{1}{2}$; penultimate whorl broader and more dilated than any of the rest; protoconch of $1\frac{1}{2}$ whorls smooth, all the other whorls sculptured with fine, rather distant, axial protractive costulations; the peristome is double with a strong columellar tooth, aperture almost vertical, peristome complete, and subcircular without angulations at base, columella arched.

Long., 1·5 mm.

Diam. max. vix 1 mm.

Habitat: Sungei Siput, Perak.

This tiny species resembles *crosseana* Nevill and G.-Austen, but differs in the shape of the aperture; in *crosseana* this is angular at the base and the columellar margin is perfectly straight. The figure should show the costulations more plainly on all the whorls except the protoconch.

Diplommatina (*Sinica*) *sinistra* n.sp. Pl. 11, Fig. 4.

About the same size as, and superficially similar to, *D.* (*Sinica*) *diminuta* [1] Möllendorff from Bukit Pondong: it is minute, sinistral, has $7\frac{1}{2}$ whorls which are convex, with deeply impressed sutures, the penultimate whorl being broader and rather more dilated than the ultimate; it has about twenty-four axial costulations on the penultimate whorl and a deep-seated columella tooth, but lacks parietal and palatal teeth; the number of costulations in *diminuta* is not stated but must be, from the figure, many more than this; aperture in *sinistra* irregularly rounded except that on the right-hand side the peristome is almost straight from its junction with the body whorl, forming a chord to the irregular arc of the rest of the peristome.

Long., 1·9 mm.; diam. max., 1 mm.

Habitat: Sungei Siput, Perak.

Stated shortly the points in which this species differs most from *diminuta* Mllff. are shape and armature of aperture and the much smaller number of costulations.

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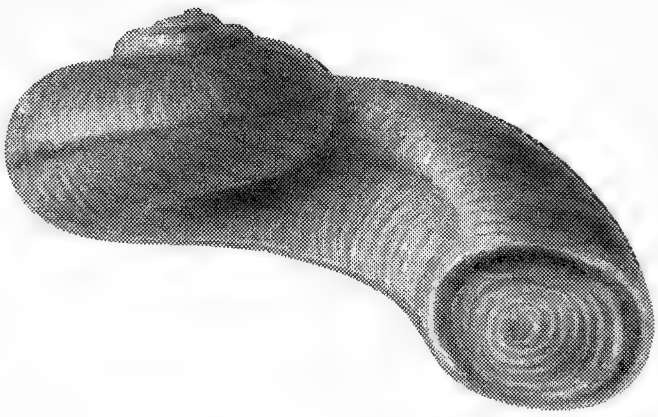
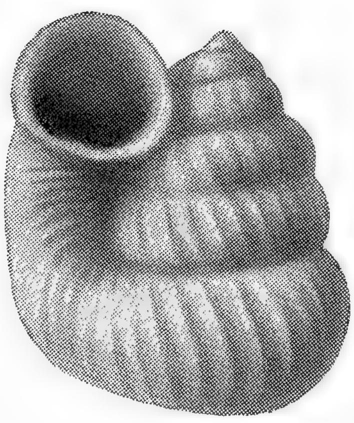
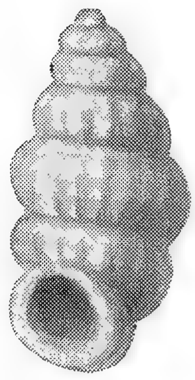
[1] *P.Z.S. London*, 1891, p. 344, pl. xxx, f. 15.

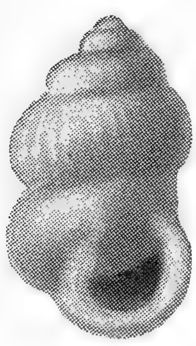


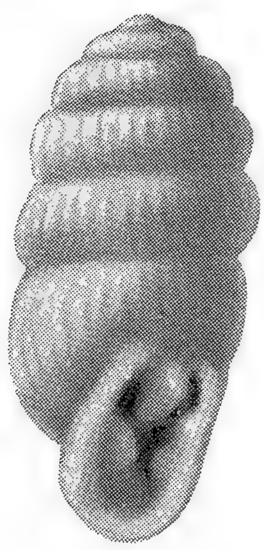
1. × 2. 2.





3. × 12. 4. × 12.





5. × 15. 6. × 12.

New Malay Land Shells.

See p. 75.

Sinoennea siputana n.sp. Pl. 11, fig. 6.

Shell regularly cylindrical, hyaline whitish, plainly and deeply perforate ; whorls seven, convex with deep sutures, apex flattened and obtuse ; protoconch of two whorls smooth ; from the third whorl down sculptured with equally spaced, rather close axial costulations of which there are about 34 on the penultimate whorl ; aperture oblong, vertical, tilted considerably to the left-hand, subangular at the upper corners, rounded off below, with a broadly dilated peristome, furnished with four dental processes, whereof one is very prominent, hook-shaped, on the paries, entering deeply, one oblong tooth is very deeply inset on the columella, while two blunt, rounded, mound-shaped ones are on the outer lip—the upper and smaller one on a level with the lower extremity of the parietal and fixed on the edge of the peristome, the lower and larger being inserted a little more within.

Long., 3 mm. ; diam. max., 1·5 mm.

Habitat : Sungei Siput, Perak.

PLATE 11.

FIGS. 1 AND 2.—*Rhiostoma chupingense* n.sp. × 2.

FIG. 3.—*Opisthostoma retrovertens* n.sp. × 12.

FIG. 4.—*Diplommatina* (*Sinica*) *sinistra* n.sp. × 12.

FIG. 5.—*D.* (*Sinica*) *siputana* n.sp. × 15.

FIG. 6.—*Sinoennea siputana* n.sp. × 12.

KING LANE POND, LEEDS.

By W. Thurgood.

(Read before the Society, 3rd April, 1937.)

This pond has long been famous among naturalists as a breeding ground of sinistral *Lymnæa peregra.*

It is now pretty well surrounded by villas and semi-villas.

Contrary to the late Lord Moynihan's wishes the land, in being parcelled out for building, has been measured to the centre of the pond, so that each tenant has had to pay for, and claims rights over, the enclosure.

In March, 1937, a pair of half-wild Mallards arrived at the pond; these were driven off by Mr. D. Fisher, acting on behalf of the Leeds Naturalists' Society. After a good many daily visits Mr. Fisher was met by two of the tenants and requested to allow the birds to nest in peace. They said that to those living round the pond the ducks and their young were of more interest even than the sinistral *L. peregra.* A copy of the *Naturalist* which dealt with the conchological interest of the pond provoked some interest, but Mr. Fisher subsequently found the gate giving access to the pond padlocked, and was unable to get at it without going to one of the owners.

Frequent visits in the last two years by Mr. Fisher and myself have only resulted in the following total "bag": two specimens each of *Planorbis corneus*, *Lymnæa stagnalis*, and *L. peregra* (dextral), seven or eight *Sphærium corneum*, and five or six *Planorbis carinatus.*

The ducks undoubtedly keep the water clean from algal growth and it seems hardly worth while, under the changed conditions, to attempt any further interference.

BIOLOGY OF TRIDACNA AND ITS RELATIVES.

[The Editor of *Nature* has very kindly given permission for the reproduction of this article in our Journal and has also obtained the author's consent. It originally appeared in *Nature*, No. 3489, vol. 138, Sat., 12th September, 1936, pp. 473–4.—Ed.]

THE largest bivalves in the world belong to the Tridacnidæ. They have always aroused much interest in conchologists although little was known of the living animals. Size is not the only distinction in the family, for Professor C. M. Yonge [1] shows that they are unique among the Lamellibranchiata in the relation of the mantle and shell to the other organs, and in the universal presence of zooxanthellæ in the tissues. In his peculiarly interesting monograph there is a large amount of new matter clearing up much that was puzzling in these gigantic molluscs, which are among the most conspicuous members of the fauna of coral reefs in the Indo-Pacific region. *Tridacna derasa*, the giant clam, may be 4½ ft. long, the largest lamellibranch ever evolved, and may weigh about 4 cwt. The largest specimens personally examined were a little more than 3 ft. in length, and were so heavy that the combined efforts of two men failed to raise them.

There are two groups in the Tridacnidæ, the smaller boring forms, living in coral rock, and the larger species lying free on the surface of the reefs. All these clams normally rest on the hinge side of the shell with the edges of the valves pointing upwards. The pedal aperture, when present, lies close to the umbo. Thus, " as a result of a turning movement in the longitudinal plane, the dorso-ventral relations of the visceral mass and associated organs, on the one hand, and of the mantle and shell on the other, have become . . . the exact opposite of those in other lamellibranchs." This has given rise to much controversy as to whether the visceral mass has moved relative to the shell or whether the mantle has moved relative to the visceral mass. Professor Yonge is now in the position to prove that the latter supposition is correct, and in this he is in agreement with Lacaze-Duthiers.

It is, however, in the amazingly efficient partnership with the zooxanthellæ that these molluscs are of outstanding interest. On this depends the whole problem of feeding, structure, and evolution. Immense numbers of these zooxanthellæ always occur in the Tridacnidæ, housed primarily in the blood cells of the inner lobes of the mantle edges on the dorsal side where they are fully exposed

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[1] British Museum (Natural History). Great Barrier Reef Expedition, 1928–9. *Scientific Reports*, vol. 1, No. 11 : Mode of Life, Feeding, Digestion, and Symbiosis with Zooxanthellæ in the Tridacnidæ. By Professor C. M. Yonge, pp. 283–321, 5 plates. (London : British Museum (Natural History), 1936.) 5*s*.

to the light. In *Tridacna* these lobes extend far over the free edges of the shell valves in life, exposing a broad sheet of highly pigmented tissue. In the allied *Hippopus*, where there are fewer zooxanthellæ, the mantle edges do not extend in this way, but the shell valves open to a greater extent. The zooxanthellæ are confined to the blood sinuses, and are invariably contained within amœboid blood cells. Conical protuberances on the mantle edge, carrying lens-like structures, hitherto regarded as eyes, are here shown to be means whereby the internal illumination of the mantle tissues is increased for the benefit of the zooxanthellæ. The phagocytes, carrying the zooxanthellæ from the mantle, surround the reduced diverticula and other regions of the gut and contain these algæ in all stages of digestion. *Tridacna*, and to a less extent *Hippopus*, consumes a number of these, so obtaining a significant amount of food.

The mouth is small, there is no sorting mechanism in the stomach, and the selective action of the gills and palps is highly developed, particles 14μ in diameter being rejected. Assimilation and intercellular digestion take place in the much-reduced digestive diverticula and also in the phagocytic blood cells which may pass through the lumen of the gut. Indigestible material remaining in the phagocytes is presumably carried to the kidneys, which explains the abnormal size of these and the presence within them of a great number of large concretions.

The Tridacnidæ are profoundly modified for the housing and final digestion of the zooxanthellæ, and *Tridacna* may be considered the supreme example of the exploitation of associated algæ by an animal, although unlike *Convoluta roscoffensis* it never loses the power of holozoic nutrition, and so only the surplus zooxanthellæ are consumed. Experiments failed to reveal any significant production of oxygen or removal of carbon dioxide by the zooxanthellæ in the light, but they automatically remove all phosphorus excreted by the animal and even the phosphorus present in the water around. This may be the limiting factor controlling their abundance.

In no case known where there is a partnership of algæ with an animal has it been so highly evolved as in *Tridacna*, resulting in the actual farming of the zooxanthellæ by the mollusc. Every stage in the evolution shows a step towards this end. In a Cardium-like ancestor, it is suggested that the zooxanthellæ first settled in the region of the siphons, having been taken in with the food and so ingested by wandering phagocytes. This partnership being of advantage to both alga and mollusc, but especially to the latter, the mollusc became so modified in structure that the largest possible

surface might be exposed in which the algæ could dwell near the light, whilst with a larger consumption of these the ordinary digestive organs were more and more reduced, a very good combined method of feeding being the result, the boring forms having evolved after this adaptation of structure and functions. It is found that boring is entirely mechanical and that the byssus takes an essential part in this process.

The Genus Nevillia H. Ad.—In the *P.Z.S.*, 1868, p. 289, pl. xxviii, figs. 2, 3, Henry Adams described this as a new genus with two species *N. picta* and *N. lucida*, the former of which is here designated as genotype. Both are fairly well figured and the main difference between them may be gathered to be the existence in *picta* of one spiral ridge much more prominent than the rest: this ridge is supra-peripheral and a series shows that there is in some examples another equally prominent one below the periphery. In *lucida* the spirals are all of equal value. Both have been turning up recently in some numbers from Mauritius. I cannot help thinking that the family of Rissoidæ in which Adams placed them is unlikely, and that near *Euchelus* may be a better shot, the absence of nacre being due to beach-rolling.—J. R. le B. Tomlin.

A NEW VARIETY OF MYA ARENARIA L.

By A. Comfort.

The shells from which the following description is prepared represent a well-marked variety, occurring in the large brackish Loch of Stennis on the southern coast of Mainland, Orkney. The loch, whose extent is several square miles, communicates with the sea by a narrow rocky channel some 20 feet across, with a second larger lake of almost fresh water on the north. The shells occur in the empty condition along a stony shore fringing the eastern side of the loch, being fairly plentiful and mixed with normal forms washed in from the sea.

Mya arenaria L. var. *corbuloides*, nov.

Shell smaller than in the typical form ($1\frac{1}{2}$ in.–1 in. $\times \frac{3}{4}$ in.), very chalky and fragile, thin, externally rugose, inequivalve, with a superficial resemblance to a very large *Corbula*. Periostracum almost entire, thick and heavily puckered, not abraded. Hinge small but definite. Type in the British Museum.

The likeness to *Corbula*, in spite of the discrepancy in size, is very noticeable, and renders the variety unlike the typical form. There is a very pronounced difference between the dwarf marine forms, which enter the loch by the Brig of Stennis and are found in a fresh condition for some yards around, and the brackish modification, which seems most frequent on the long stony spur leading to the Brig of Brodgar. Along the northern shore the shells are progressively less frequent, owing to the prevailing westerly wind.

The peculiar set of conditions within the two lakes of Harray and Stennis, whereby every gradation from salt to fresh water is successively produced, has caused the evolution of the curious Orkney strain of *Theodoxus*, and the *Mya* here described seems to have arisen in a similar way. They do not seem to penetrate to the Loch of Harray, their true habitat being probably in the deeper parts of Stennis, whence the empty shells are washed or blown to the stations quoted.

Other mollusca reported in the vicinity are *Lymnæa peregra*, *Hydrobia jenkinsi*, and the *Theodoxus* already cited. Two *Littorinas*, *littorea* and *littoralis*, penetrate to within a few dozen yards of the seaward bridge, but disappear as the fuci become replaced by confervæ.

NEW SUBGENUS AND GENUS OF TERTIARY PECTINIDS.

By H. I. Tucker Rowland.

It has been the practice to refer to *Lyropecten* Conrad, 1863, two species of shells which differ conspicuously from the genotype, "*Pallium*" *estrellanum* Conrad, by subsequent designation, Dall, Wagner Free Inst. Sci., Trans., *3* (*4*): 695, 1898. Both *ernestsmithi* (Tucker) and *caloosaënsis* Dall occur in the Pliocene of the Atlantic Coast of the United States. The former was described from the Waccamaw Pliocene of North Carolina, the latter from the Caloosahatchie Pliocene of Florida, and both occur in the Caloosahatchie. So far as is known, *caloosaënsis* occurs only in the Florida beds. For these species *Stralopecten* is proposed, with *Stralopecten ernestsmithi* (Tucker) as the genotype, Mus. Roy. d'Hist. Nat. de Belgique, Mém., sér. 2, fasc. *13* : 27, pl. ii, fig. 7, 1938. To this genus is also referred *P. caloosaënsis* Dall, 1898.

Diagnosis.—Shell only moderately heavy; more or less triangularly suborbicular, usually higher than wide; sub-equivalve, moderately convex, equilateral; radial sculpture of very few ribs, 5–7, very strong, well elevated, with a strong secondary radial sculpture of cords or threads on their summits. Interspaces may or may not be radially sculptured, quite wide; concentric sculpture weak or absent. Auricles large, triangular, widest at the cardinal margin and pointed at the distal cardinal angle, usually with well-developed radial sculpture. Byssal notch wide, shallow; byssal fasciole conspicuous; ctenolium strong, persistent in adults. Interior reflects external ribs and interspaces; cardinal crura obsolete in adults, auricular crura absent; chondrophore only moderately large.

From *Lyropecten* this genus is easily distinguishable by the shape of its auricles, very moderate number of ribs, and differences in hinge structure. "*Pallium*" *estrellanum* Conrad has very strong auricular crura. Arnold, U.S. Geol. Surv., Prof. Paper *47* : pls. xx–xxi, 1906, has well illustrated the genotype of *Lyropecten*.

This genus is named in honour of Dr. Victor van Straelen, Director of the Musée Royal d'Histoire Naturelle de Belgique.

It has been rather common practice to refer to *Janira* Schumacher, 1817, those Pectens which have a very convex right valve, flat or even concave left valve, obsolete byssal sinus, a moderate number of well defined simple ribs, recurved beaks.

Janira Schumacher, *Ess. Nouv. Syst.*, 117–18, pl. iii, fig. 4, 1817, is a synonym of *Pecten* Müller.[1] Schumacher lists as his first species

[1] Rowland, "Nomenclatorial Units of the Tertiary Pectinidæ," *Mus. Roy. d'Hist. Nat. de Belgique Bulletin.* (In press.)

"*Ostrea*" *maxima* Linné, and designates his *intermedia* as the genotype. His figure leaves no doubt that this species is, at best, a variety of *maxima*. For this group the new subgeneric name of *Convexopecten* is here proposed, with genotype *Pecten* (*Convexopecten*) *josslingi* (Smith), *Quart. Jour. London Geol. Soc.*, *3* : 419, pl. xvi, figs. 10–12, 1847.

Diagnosis.—Shell with right valve very convex, left valve flat or even concave ; beak strongly recurved ; equilateral to slightly subequilateral ; orbicular to somewhat higher than wide ; auricles usually equal, squarely terminated ; byssal notch obsolete ; moderate number of simple, well-defined ribs, varying from more or less rounded in cross-section to rectangular, sometimes with secondary radial sculpture on their summits ; concentric sculpture may or may not be present.

Perhaps this subgenus is most closely approached by the West Indian *Euvola* Dall, 1898, from which it is very easily separable. The genotype of *Euvola*, *ziczac* (Linné), has a less strongly recurved beak, is broader in proportion to its height, has low, broad, flat ribs separated only by narrow sulci.

NOTES ON NASSARIUS.

By J. R. le B. Tomlin.

By the courtesy of the authorities of the Free Public Museums at Liverpool I have been allowed to study at leisure the specimens of *Nassarius* formerly in the collection of F. P. Marrat, on which he based many new species. As is well known he published several papers on this genus, the longest being " On the Varieties of the Shells belonging to the Genus *Nassa* " (1880), and though he described many new species he often gave it as his mature opinion that all *Nassa* were one single variable species.

The present note is only concerned with stating one or two interesting facts that have emerged in the course of the study.

Nassa acuminata Marrat.

" Var. Gen. Nassa," p. 78, 1880. No locality. The single example is identical with Schepman's *elegantula* (*Siboga Prosobranchia*, p. 315, 1911) which will take Marrat's name.

Nassa nodulosa Marrat.

Ann. Mag. Nat. Hist. (4) xii, p. 426, 1873. Hab ? Later on the locality was given as China Seas. There are four syntypes which are identical with the species described by Melvill as *Nassa* (*Hebra*) *polychroma* in *Ann. Mag. Nat. Hist.* (7) i, 198, pl. xii, f. 1, 1898, from Aden.

Nassa rissoides Marrat.

On Some Proposed New Forms in the Genus Nassa, p. 14, pl. i, f. 25, 1877. Hab.?

The two examples of this species belong to the genus *Chauvetia* and are the species *candidissima* (Phil.) described from Catania as " rarissima ". It was recorded by Dautzenberg from West Africa in his report of the Mission Gruvel.

Nassa vincta Marrat.

Op. cit., p. 12, 1877. Hab ?

There are five good specimens of this, which enable one to identify it with Martens's *circumtexta* (1903)—a name which is therefore superseded.

I have also had the opportunity of seeing twenty-three lots labelled with MS. names which fortunately never attained publication.

The following five published names are nude :—
variabilis var. *costata* Marrat.
glabrata M.
luteola M.
nivifer M.
scalariformis M.

THRACIA ANTARCTICA M. & S. AND MYA ANTARCTICA M. & S.

By J. R. le B. Tomlin.

In 1898 Melvill and Standen published a description and figures of the above *Thracia* in this Journal, vol. ix, p. 105, pl. i, f. 13, 13*a*, 1898, from a specimen collected by Miss Cobb on Lively Island in the E. Falklands.

Sixteen years later they described a *Mya antarctica* from a shell collected by Vallentin in the N.W. Falklands (see *Ann. Mag. Nat. Hist.* (8), xiii, p. 134, pl. vii, f. 6, 6*a*, 1914.

The resemblance of this *Mya* to the shell previously described as a *Thracia* did not escape the authors' notice and they " think it possible this may be the same species ". The hinge in the *Thracia* is undoubtedly abnormal ; there is a large and prominent tooth which ought not to be there in the left valve, and a portion of the hinge-line in the right valve is broken away.

In view of the fact that no *Mya* was known from the Southern hemisphere it would probably have been better for the time being to abstain from introducing one.

As a matter of fact both these shells are young examples of *Anatina*[1] *elliptica* King and Broderip, described from the South Shetlands, and now known to have a wide range in Kerguelen and other Antarctic localities.

---

[1] *Zool. Journal*, vol. v, p. 335, 1832.

EDITORIAL NOTES.

THE Society has sustained yet another serious loss by the death of Lieut.-Colonel W. H. Turton.

His health broke down in 1935 and he was obliged to leave Clifton, where he had spent many years; he went first to Minehead for a year and then to a small house he had purchased at Northlew, in the neighbourhood of Okehampton. Both these moves had to be made in an ambulance, and the end came very peacefully on 16th June, a few months after his move to Northlew.

In the course of the last two or three years Dr. W. Adam, either alone or in collaboration with M. E. Leloup, has published several very interesting papers on additions to the molluscan fauna of Belgium.

These notes have all appeared in the *Bull. Mus. Hist. Nat. Belgique*: No. 45, vol. x, records the first occurrences of *Crepidula fornicata* L. on the Belgian coast from 1911 onwards and mentions that it is now common on the oyster-beds at Ostend and Blankenberghe. The paper also discusses mode of distribution and includes an up-to-date bibliography.

No. 30 of vol. xi records the presence of *Arion intermedius* Normand in several localities and discusses very fully the use and synonymy of this name.

No. 38 of vol. xi confirms the occurrence of *Helicella virgata* da Costa in Belgium, whence it was originally recorded by Malzine in 1867 as *Helix variabilis* Drap.

No. 11 of vol. xiii records the discovery of two new Belgian snails: *Cochlostoma septemspirale* Raz., taken in 1929 at Munte-lez-Gand, and most likely an importation, and *Helicella cespitum* Drap., in the neighbourhood of Antwerp, certainly an accidental introduction though like the *Cochlostoma* it was taken alive.

No. 10 of vol. xiii records further occurrences of *H. virgata* in the course of the last two years, with several good photographs which almost all represent what we in England consider the typical form.

The writers contrast the statements of Germain and Boycott as regards the length of life of this species: Germain says, "On trouve en France de jeunes adultes à partir du milieu de leur seconde année." Boycott vouches for it that in this country most of the adult *virgata* die in winter; the species, he says, is an annual, the eggs are laid in autumn and the young appear in spring. Adam and Leloup consider that their experience confirms Boycott's dictum, but suggest the probability that creatures in the south may undergo a different life cycle from those that live in the north.

In this same paper they announce the discovery of a large colony of *Theba pisana* Müller at Mariakerke.

The habitat is limited, but the snails are in thousands on bushes of *Lycium barbarum* L. When first discovered on 12th June, 1936, there were only young examples, most of which still had the angular shell; on 26th June a few adults were found; on 13th August and 28th August there were very few young but adults in vast numbers, and eggs were seen to be laid on 14th August.

In No. 6 of vol. xiv Dr. Adam lists and comments on the Clausiliidæ of Belgium: omitting a certainly erroneous record of *itala* Mts. the list contains *Balea perversa* L. and nine Clausilias, of which we do not possess *parvula* Studer, *lineolata* Held, *ventricosa* Drap., or *plicatula* Drap.

No. 10 of vol. xi contains a paper on the distribution of *H. aspersa* Müller in Belgium, and a map showing the known localities for this species and for *H. pomatia* L. It appears that *H. aspersa* is by no means universal in

Belgium, and the authors discuss the factors which may tend to limit its distribution.

A short but very interesting paper by F. B. Loomis in the *Journal of Paleontology*, vol. 10, p. 663, 1936, calls attention to an obscure and little understood group of minute fossils known as Conodonts.

These are horny or chitinous tooth-like objects, from ·25 to a little over 1 mm. in length, which occur in great numbers in certain types of sediments and are so far only reported from Palæozoic formations. They have been variously identified as the jaws of annelid worms, as teeth from the gill-rakers of fish, and as teeth from molluscan radulæ. Their similarity to individual teeth of radulæ was noted more than half a century ago and Mr. Loomis has no doubt that this similarity in shape, size, and composition is more than accidental—in fine that Conodonts and the radular teeth of Gastropods must belong to the same group of organisms.

In illustration of his contention he figures teeth from the radulæ of six Gastropod genera, viz. *Nassa*, *Fulgur*, *Buccinum*, *Littorina*, *Trochus*, and *Haliotis*, alongside the Conodont forms which he conceives to resemble them most closely. Lieut.-Col. Peile, however, tells me that Loomis' figures of recent radulæ are so crude that they carry no conviction with them even when compared with his reproductions of figures of Conodonts, and when compared with the *original* figures of some of the Conodont authors the comparison is even less convincing.

The Royal Zoological Society of Belgium held an extraordinary séance in May to commemorate the seventy-fifth anniversary of its foundation. We believe that we are correct in saying that this Society was founded on 1st January, 1863, as the Malacological Society of Belgium.

The papers read at the May celebration related mainly to the Belgian Congo, and a natural history film was shown from the national parks of this territory.

The following Address was presented to the Linnean Society on 24th May last on the occasion of its centenary celebrations. The address was most attractively produced in black letter by our printers :—

" The Conchological Society of Great Britain and Ireland sends cordial greetings and hearty congratulations to the Linnean Society on the occasion of the completion of a century and a half of continuous usefulness. It desires to associate itself with other representatives of science and learning at home and abroad in expressing appreciation of the scientific work accomplished during the long period of the Society's existence. The researches of the Linnean Society have in many ways proved beneficial to those engaged in the study of Conchology, and, in addition to the fact that the Linnean Society has in its keeping the famous collections of Carl von Linné which include forms belonging to the molluscan phylum, the Conchological Society recalls with much satisfaction and pride that it numbers on its roll of members and Presidents many Fellows and Associates of the Linnean Society who have made important contributions to knowledge.

" In sending its greetings through its Delegate and Hon. Editor, Mr. J. R. le Brockton Tomlin, M.A., F.R.E.S., the Conchological Society expresses the sincere wish that the Linnean Society may long continue to flourish and to maintain its glorious traditions.

CYRIL DIVER,
President.
J. W. JACKSON,
Hon. Secretary.

Date : 24th May, 1938."

The Assistant Editor of the *Geographical Magazine*, 40–42 Chandos Street, W.C. 2, writes as follows :—

23rd March, 1938.

THE EDITOR,
Journal of Conchology,
THE UNIVERSITY,
MANCHESTER.

DEAR SIR,

I am enclosing an extract from an article on the Great Barrier Reef by T. C. Roughley, which appears in the current April number of the *Geographical Magazine*, and which may be of interest to your readers.

Yours faithfully,
H. H. HINDMARSH.

The Great Barrier Reef, Australia's 1,200 mile breakwater off the coast of Queensland, has long been known as a treasure house of the wonders of marine life in coral seas. Recently Mr. T. C. Roughley, Economic Zoologist of the Technological Museum of Sydney, spent two winters exploring these islands and reefs, and in an article in the current April number of the British *Geographical Magazine*, he describes some of the results of his observations on shells and shellfish.

Referring to curious specimens of crabs he says : " On one of the islands of the reef I was once collecting shells on the shore where they lay in millions about a foot deep, and leaving my collection on the sand above high tide mark for about half an hour I was astonished to find on my return that fully 20 per cent had crawled away. They were dead shells, but they formed the temporary abode of crabs which, on account of the softness of the hinder portion of their bodies, seek empty shells to conceal and protect their nakedness. As the crab grows it finds its quarters become uncomfortably restricted and it must perforce find a more commodious home ; it therefore searches for a larger shell, when it leaves the old one and backs into the new."

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN & IRELAND.

651st (Joint) Meeting, held at the Manchester Museum, 2nd April, 1938.

The President, Captain Cyril Diver, in the chair.

Present.—Messrs. B. Bryan, A. K. Lawson, E. Dearing, F. Taylor, C. H. Moore, G. C. Spence, Mrs. Morehouse, Mrs. N. F. McMillan, Mr. and Mrs. J. C. North, Mr. and Mrs. W. Thurgood, Mr. and Mrs. G. Stead, and Dr. J. W. Jackson.

Apology for absence received from H. Emmett.

The Minutes of the Meeting of 12th March were read and confirmed.

The Librarian reported several additions to the Library.

Member Deceased.

J. H. Goodson.

Address by the President.

The President gave a short address " On the Snail Fauna of Acid Heathland ", derived from a general ecological survey of Studland Heath in Dorset.

Mrs. N. F. McMillan also read a paper on Lamellaria.

Exhibits.

By Mrs. N. F. McMillan : Specimens to illustrate her paper, including typical *Lamellaria perspicua* (L.) from Plymouth and another locality, and *Lamellaria latens* (Müller) from Greenisland, Belfast Lough, both determined by Dr. Nils Odhner ; also coloured sketches to show typical colouration of both species.

By Mr. A. K. Lawson : *Cypraea decipiens* (Smith) from N.W. Australia, *C. mappa* (L.), Pacific Ocean, and *C. tigris* (L.) vars.

By Mrs. Morehouse : Land and marine shells from Cornwall.

By Mr. B. Bryan (for City of Stoke-on-Trent, Hanley Museum) : Twenty-five boxes of Helicidæ, including several of the *Candidula* group, from the collection of the late Mr. R. Cairns.

By Mr. G. C. Spence : A number of Urocoptids, mainly from Cuba ; also pieces of wood from the bottoms of whale boats (sent out from England) showing damage caused by *Teredo* after three months' service on the Gold Coast (Volta River), West Africa, 1937.

By Mr. C. H. Moore : A selection from the J. W. Taylor collection showing a new method of mounting.

652nd Meeting, held at the Manchester Museum, 7th May, 1938.

Mr. G. C. Spence in the chair.

Apologies for absence from A. K. Lawson and Mrs. N. F. McMillan.

The Minutes of the Joint Meeting of 2nd April were read and confirmed.

The Librarian reported additions to the Library.

Candidates Proposed for Membership.

Tom Burch, 1611 South Elena Avenue, Redondo Beach, California, U.S.A. (introduced by Mrs. Morehouse and Dr. J. W. Jackson).

Joseph M. Grech, 29 Sda Dietro, S. Ubaldesca, Paula, Malta (introduced by Guy L. Wilkins and J. W. Jackson).

Member Deceased.

Rev. G. A. Frank Knight.

Member Resigned.

Dr. Stanley Colyer (as from the end of the present year).

Papers Read.

" Investigation of the Distribution and Habitats in Northern Britain of Clausilia cravenensis Taylor," by Rev. E. Percy Blackburn.

" Note on the Mollusca of the Loch of Stennis, Mainland of Orkney," by Alexander Comfort.

Exhibits.

By Mr. C. H. Moore : *Paryphanta busbyi* (Gray), coloured forms from Auckland, New Zealand : *Helix aspersa* from Italy : *Xerophila variabilis* Drap. from olive trees, Seville : *Acanthinula lamellata*, etc., from Burnham Beeches.

By Mr. G. C. Spence : African Ligatellas ; also string of shell-disk money from Choiseul Is., Solomons.

By Dr. J. W. Jackson : *Theodoxus fluviatilis* from various localities (from the Society's collection and from other sources).

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A SURREY BRONZE AGE INTERMENT.

By A. E. Ellis.

(*Read before the Society*, 12*th November*, 1938).

In the course of trench digging operations on 29th September, 1938, in the grounds of Epsom College, Surrey, a flint-lined grave, containing the remains of a human skeleton, was excavated. The interment has been assigned to the early Bronze Age, about 1,800 B.C. Associated with the human bones were those of voles and shrews, and also shells of the following species of land snails :—

Pomatias elegans (Müll.), in great quantity.
Vallonia excentrica Sterki.
Cecilioides acicula (Müll.), in the bones themselves.
Cochlicopa lubrica (Müll.).
Goniodiscus rotundatus (Müll.).
Marpessa laminata (Montagu).
Xerophila itala (L.).
Trochulus hispidus (L.).
Vortex lapicida (L.).
Cepaea nemoralis (L.).
Retinella pura (Alder).
Retinella nitidula (Drap.).
Oxychilus cellarium (Müll.).
Vitrea crystallina (Müll.).

The shells of *Cepaea nemoralis* comprised the following band-formulæ :—12345 : 28 specimens ; 123(45) : 12 specimens ; (12)3(45) : 2 specimens ; 00300 : 8 specimens ; 00000 : 8 specimens. The proportions are approximately 5 five-banded : 1 single-banded : 1 bandless.

I am indebted to Mr. A. S. Kennard for his kind assistance in determining the species and age of these shells.

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ASPECTS OF THE STUDY OF VARIATION IN SNAILS.

By Cyril Diver.

(Presidential Address delivered at the Annual Meeting, 15th October, 1938.)

Table of Contents.

Introductory.

It would be impossible in a single paper to review the whole field of molluscan variation in all its many aspects; and I shall attempt no more here than to direct attention to a few problems and, with particular reference to the British non-marine fauna, to indicate certain fields where important work is urgently waiting to be done. Since my object is to consider variation in relation to snails, I have drawn my examples mainly from this single group of organisms and even within these limits I have only referred to such work as may serve to illustrate the various points I wish to make. A wide survey of molluscan literature was made by Pelseneer (1920) during the war years, but since that date the rapid growth of genetics and ecology has shown many facts in a new light. Much of the more recent work has been reviewed by Robson and Richards (1936) in their general treatment of variations in nature. But in spite of the imposing bibliography that could be compiled from these

and other sources, there is hardly a species of which we can say we have a real knowledge of the extent and limits of its variability, of the behaviour and distribution of its varieties, or of the part that variation has played in producing and preserving that distinct identity which enables us to recognize it as a "good" species.

The intensive specialization of recent decades has resulted in the separation of biologists into a number of distinct and almost discontinuous groups between which are barriers of terminology and outlook almost as formidable in their isolation effects as those that separate species. While these exist the free interchange of knowledge is impeded, concerted advance becomes difficult, and much potentially valuable work is still-born. Variability is an essential quality of living matter, and its effects must be taken into account wherever our particular centre of interest lies—whether in systematics, morphology, ecology, genetics, or palæontology. The problems presented by its study are such as we can only hope to solve through a close co-operation between many lines of research; and every naturalist and field collector can readily elicit facts without which no true solution is likely to be reached.

The early naturalists were properly concerned mainly with reducing the manifold expressions of life to some order capable of classification. For this purpose it was obviously stability, and not variation, which was of primary importance. In fact, particularly while the doctrine of special creation still held sway, variation not only had no theoretical importance but was a practical nuisance and embarrassment to taxonomy. This view has died hard in some quarters, and there have been those who would put an awkward specimen "under the heel" without realizing that they were probably destroying far more valuable information than they were preserving. This necessary concentration on stability gave rise to the idea of the type specimen—a concept of great taxonomic value but having very little biological meaning. A certain amount of misunderstanding has been caused in the past by the failure to keep this very practical and useful concept in its proper place. Such troubles usually arise from a lack of understanding of the difficulties that confront the taxonomist and the severe limitations under which he must inevitably work. It is well for the ecologist and the geneticist to remember that they could hardly proceed without the accurate framework which the taxonomist has already built up; and it is for them to supply the additional facts which should enable taxonomy to reach its fullest development.

With the acceptance of the theory of evolution the rôle of variability became obvious—for without it no evolutionary change could take place. But, after Darwin's own contributions, little more was

done though a great deal was said. In 1894, Bateson was still inveighing against the neglect of this study and the consequent barrenness of morphological speculations. He rightly submitted that "to collect and codify the facts of variation . . . is the first duty of the naturalist", and characteristically set himself to this task. The result was his *Materials for the Study of Variation.* In this work he demonstrated that discontinuous, as opposed to continuous, variation was a widespread phenomenon. Had Mendel's earlier experimental work not been rescued from oblivion a few years after this, it seems more than likely that Bateson from his own direct observations would independently have reached one of the principal discoveries of modern biology. Simultaneously Pearson, Weldon, and others were attacking continuous variation along biometrical lines. The continuance of this work of collecting and codifying the facts is still essential to progress. There is a vast field open to study and mollusca are some of the best material for the purpose.

This historical sequence coupled with the predominance of the morphological outlook and the fact that variations, however much they may have been neglected by other workers, are forced upon the systematist and the collector, led to a concentration on the purely morphological aspects of variability. In fact, since the taxonomist in the vast majority of species must inevitably work on dead material unsupported by adequate field or ecological data, there is seldom any other aspect open to him. In consequence, the statement that a species varies still often conveys no more than the limited idea that all its individuals do not strictly conform to the morphological type ; and to many of the conchologists who tend to neglect the animal itself it is entirely restricted to variations of the shell. Obviously, the soft parts are just as liable to vary as are the hard parts (Pelseneer, 1920), but the type of variation they display is often difficult to observe and measure and is tiresome to preserve. The result is that, although a good deal is known about the range of variation in the one case, very little is known about it in the other. Cytogenetics has now shown that, at least in certain cases, the study of morphological variation can be carried right down to the individual chromosome.

In *Cepæa* and *Limnæa*, for instance, variations of the shell have been carefully described in great number and many have been named ; but it is not so easy to find adequate descriptions of the interesting and sometimes important differences in, say, the distribution of pigment in the soft parts. The work of Aubertin (1927) on the variation of the soft parts of *Cepæa* is a striking exception. In considering the problem how two such close species

as *C. nemoralis* (L.) and *C. hortensis* (Müll.) came to be separated, and by what mechanism they preserve their specific identities, we need to know their range of variation in many different types of attribute. The courtship behaviour, the general habits, and the range of habitats of *C. hortensis* are just as diagnostic as are the shape of its spire, the structure of its radula or the number of its mucous glands.

The typical habitats, or general ecology, of the British non-marine species are fairly well known, and the whole of this subject has received masterly treatment at the hands of Boycott (1934, 1936); but in no species do we know what may be called its entire "range of tolerance", that is to say the extreme limiting conditions beyond which the species cannot or does not ever live. These facts are essential to an understanding of evolutionary mechanisms. Two closely related species may appear to show an ecological separation which might provide an effective barrier to cross-mating by preventing breeding adults from ever coming into contact; but a close examination of their respective ranges of tolerance by such methods as are being employed in the South Haven Peninsula Survey in Dorset (Diver and Good, 1934; Diver, 1938*a*) may show that this barrier is illusory or at least partial. In certain conditions the two species may be found to overlap so that one is sparsely represented in populations of the other, and unless it is otherwise prevented cross-breeding may well take place (cf. Boettger, 1921) with possible effects which will be described later (p. 133.)

In many closely related species of snails there is no evidence of effective isolation by ecological barriers but small differences in habits and behaviour, particularly in courtship, may be equally effective. As yet very few detailed or comparative bionomical studies have been attempted, though good descriptions of the courtship of a few species, e.g. Adams (1898, 1910) on *Limax* and *Arion*, have appeared. In this important and fascinating field we do not in most cases even know the typical behaviour and far less its possible range of variation.

The serious neglect of these aspects, which may be studied by any naturalist with the requisite patience, greatly hinders advances in evolutionary theory; for bionomical, ecological, as well as morphological, variation is the raw material from which local races, subspecies, and ultimately species must be built up.

THE THEORY OF LIMITED VARIABILITY.

Discussions on this subject do not always clearly differentiate between variation and variability and if this is not done some confusion of thought may arise. Variability, or the *capacity* to

vary, is not always or necessarily expressed in actual variation. If we consider an isolated population homogeneous in the sense that it is entirely composed of typical individuals (e.g. a population of *C. hortensis* which in respect of shell characters contains only yellow, five-banded, white-lipped shells), we may properly say that, since it contains no variants, it displays no variation; but we should not be correct in inferring from this fact alone that the population was also without that same degree of inherent variability which we have learnt from other populations to associate with this particular species. Unless we are aware of other factors which may have reduced the normal variability, we may reasonably assume that, if whatever may be the appropriate stimuli are applied, the expected variations would appear. These may seem rather theoretical considerations, but the need for them becomes obvious when the facts suggest that the amount of variation displayed by a geographical series of populations is decreasing, say, from east to west or from the centre to the periphery of the geographical range of the species (e.g. if the populations of *C. hortensis* from southern England were shown to contain more variants than those in Iceland or Labrador). Similar considerations apply to the time-sequences presented to the palæontologist and it is clearly important to determine whether or not the inherent variability of the species has in fact been reduced. This is not the same thing as the reduction of the rate at which certain mutations are produced or distributed, but rather the possible inability to display them phenotypically at all. There is scope for much work here, both in the study of geographical series and in the comparison of fossil and recent populations of the same species (cf. Diver, 1929).

As the doctrine of evolution became accepted there appears to have grown up also a general idea that variability was illimitable. If we look at the behaviour of living matter as a whole, this concept is, if not correct, at least reasonable; but if we consider a smaller assemblage of genetically related organisms such as a species, a genus, or a family, this is obviously not correct. If it were, any division of organisms into recognizable taxonomic assemblages would be impossible. Since, by taking a comparative view of the organisms existing at any given cross-section in time, practice has shown that such divisions can be made in most cases with considerably accuracy, it must follow either that variability is limited, or that though theoretically unlimited it in practice behaves as if it were limited. We need hardly hesitate in choosing between these alternatives and we may safely proceed on the assumption that within a genetically related assemblage variability is limited. We do not seriously expect that a mating between a pair of donkeys

will give rise to a litter of pigs, nor that *Helix aspersa* Müll. will produce *Cepæa nemoralis.* On the other hand, though to-day *C. nemoralis* and *C. hortensis* are without doubt separate species, we do assume that in the remote past their common ancestor possessed a degree of variability which was at least potentially capable of producing the two fields of variability these species display to-day. Behind this again we might expect to find an assemblage of potentially inter-breeding organisms which gave rise to the whole field covered by the genus *Cepæa.* If this view be carried farther back to the origin of life, it might seem to lead to the paradox put forward by Bateson in his presidential address to the British Association at Melbourne in 1914 (reprinted in Bateson, 1928, see p. 292). But this is not so. Bateson said: "If then we have to dispense, as seems likely, with any addition from without we must begin seriously to consider whether the course of evolution can at all reasonably be represented as an unpacking of an original complex which contained within itself the whole range of diversity which living things present." The difficulty of his position was that, because he could see no mechanism by which new potentialities might be added to the original stock he assumed that the only alternative was progressive loss; and this view was strengthened by his "presence and absence" theory of genetic dominance. If his sentence be shorn of its first, and as I think unnecessary, conditional clause, the problem he propounded is worthy of more careful consideration than it appears to have received. If Bateson was incorrect in supposing that no extrinsic additions could be made, and that the course of evolution has been the development of a number of lines each characterized (whether through direct loss or the removal of inhibitions) by a contracting field of potentiality we are left not with one but two alternatives. Either extrinsic additions can be made and the inherent variability of living matter has been increased, or it has remained substantially the same and the rôle of evolutionary development has been a perpetual *shifting of the emphasis* brought about perhaps by the interplay of a vastly complex series of inhibitions and releases.

The problem may be approached from several different angles. It may be said that *C. hortensis* is less variable than *C. nemoralis*, but what is meant is that when the two species are compared it is found either that the whole specific assemblage of *hortensis* contains fewer recognizable variants than the specific assemblage of *nemoralis*, or that individual populations of the former are usually composed of fewer such variants than those of the latter. In fact, in this case the evidence suggests that both these conditions are true. But it would not be justifiable to infer from these facts alone that

the inherent variability of *hortensis* was necessarily less than that of *nemoralis*, though this may well be so. If for the moment we assume that this is true and follow Taylor (1907–1914) in regarding *hortensis* as the more ancient species from an early stage in the development of which *nemoralis* has presumably been split off, it might be argued that variability has been increased by this evolutionary process. But apart from these three assumptions there are many other traps in such an argument. It is, for instance, by no means certain that the variability of a species remains the same throughout its evolutionary life. Palæontologists find that comparatively stable lineages may pass through bursts of variation to return later again to a more stable condition. Warren's (1937) detailed research into the butterfly genus *Erebia* has led him to the conclusion that the different species of this genus undergo waves of variation which, at one stage in their phylogeny, will affect superficial characters like colour and pattern while, at another stage, structural characters such as the genitalia. Here we have facts indicating changes in the amount of variation ; but what must be determined is whether these changes are merely a response to a change in the stimuli which provoke variations or whether they are correlated with a real increase or decrease in intrinsic variability.

It is possible to consider a species as having a life analogous to that of the soma of the individual which as Weismann pointed out (see Wilson, 1925, pp. 12–13) is a mere excrescence on the germ-track. On this analogy, once the rearrangements or changes of emphasis have proceeded far enough to isolate an assemblage from the effects of out-breeding with other assemblages the species may be said to have started its independent life. A process of rearrangement will of necessity entail both internal and external adjustments, and these adjustments are likely to be accelerated if they synchronize with a free expression of variability, that is with a period of marked phenotypic variation. Such a condition ensures adaptability in relation to the external environment—a quality essential to the success of a species (Diver, 1936). Now if the process of specific evolution leads, as the mathematical theories of Fisher (1930*a*), Wright (1931), and Haldane (1932) seem to suggest, to closer and closer adaptation, the quality of wide adaptability will disappear and the species will pass into senescence, with a probable real decrease in its variability, until it reaches extinction through an ultimate failure to re-adapt itself to the ever-changing conditions of its external environment. It is not through such matured by-products that the stream of life can continue.

Turning now from the species to the individual, one simple fact inevitably limits its variability. An organism is a highly complex

unit which, if it is to survive at all, must be able to function as a satisfactory working whole. To achieve this, not only must there be a close co-ordination between the functioning of all its parts, but the complete unit must also be able to fit itself into the external environment. Thus, the organism would seem to be faced with two antithetic requirements, a close internal adaptation and a wide external adaptability. But this is not quite the whole story. Variations are perpetually occurring. Some may affect vital organs in which a small maladjustment would cause immediate death, while others such as changes in pigmentation and pattern may be entirely superficial, in no way disturbing internal efficiency and at the worst producing a slightly deleterious effect in relation to the external environment. The more complex internal organization becomes the greater is the need for some buffering mechanisms which can at least partially counteract the ill effects of indiscriminate variation. The power of organisms to make compensating adjustments during development is well known ; and we see that adaptability is in fact as great an asset in the one field as in the other.

The advance of genetics in recent years has supplied facts which confirm this line of argument. As should be expected a large proportion of the mutations that have arisen in genetic cultures are slightly disadvantageous to the survival of the individual and another large class is lethal in a homozygous condition (for a discussion of the evolutionary aspects of this problem see Sturtevant, 1937). There appear also to be mechanisms by which the species may be to some extent protected from the disadvantages while preserving the potential advantage of a display of phenotypic variation (e.g. Fisher, 1930*b*).

What then is the picture we may draw ? A species is not just an amorphous assemblage that may readily pass into something quite different, but is the expression of the particular slowly modified physico-chemical constitution brought down to it along the germ track. Though the chemical constituents of organized matter may theoretically be capable of an almost unlimited variation and have in fact during the slow process of time made a man out of something like *Chaos*, the variability of that balanced organization which forms the genetic basis of a species is clearly restricted, because any sudden gross change is liable to upset this balance and so lead to a complete breakdown in the organization. If we represent the whole field of the variability of a contemporary species by a sphere, this may be regarded as being composed of several layers or decreasing concentric spheres corresponding to the increasing practical limitation of variability. In the outer layers will lie those attributes or characters capable of expressing the greatest variability with the

least disturbance to the organism. Passing inwards from these through layers of decreasing variability, a solid central core will be reached containing those necessarily stable characters in which anything more than the smallest variation is liable to result in immediate lethality. It should be noted that there are often characters which would certainly not be placed in this central core in that they seem quite superficial and of no particular importance to the organism or the species, but which nevertheless remain quite unvaried for long periods of time. These may be accidents of genetic or chemical correlation which in no way affect the picture. Further, it is not suggested that in actuality these spheres bear any close relation to a perfect geometrical figure ; they are here put forward purely for diagrammatic purposes.

For the purpose of analysis an organism may be treated as if it were the complex resultant of a number of different characters or attributes each of which may be individually considered and

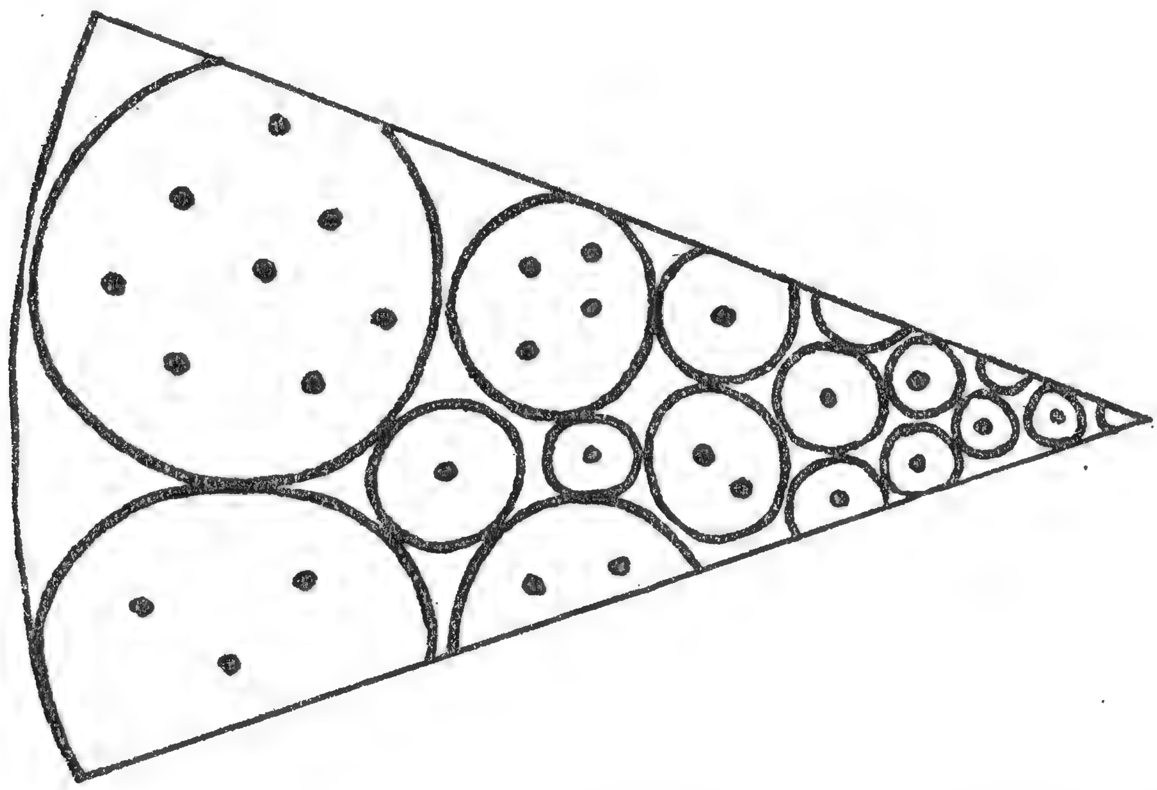

FIG. 1.—A sector of the "sphere of variability". For explanation see text.

diagrammatically represented as a spherule of variability. On this model our sphere will be built up of a large number of these smaller units which will vary in size and will tend on the average to be arranged with the largest at the periphery and the smallest at the centre. Now, suppose we represent each actually observed variant by a solid particle or dot (see Fig. 1), then in any given species many spherules will contain only one dot (representing the typical expression of the character), but a few will contain many. It should be noted that this diagram is meant to be a purely objective representation of fact and the dots within the spherules do not represent allelomorphic states of particular genes. Many different

genes may, in fact, be concerned in the production of a single character and its various expressions, and the same genes may affect different characters.

In *Cepæa*, for example, the characters of the dart hardly vary, those of the mucous glands have several variants, and there are quite a number of different expressions of the single attribute " ground cover of the shell ".

The Behaviour and Classification of Variation.

Continuous and Discontinuous Variation.

The examination of a large, naturally varying population suggests that its variations can be put into two categories, those of which the different expressions are sharply discontinuous and those that can be arranged in a continuous or graded series. This distinction was at one time thought to be significant, but the advance of genetic analysis has changed this view. It cannot be said either that discontinuous variation is necessarily genetic or that continuous variation is not inherited. It is, however, generally true that the non-genetic response of an organism to its environment often appears as continuous variation and that much inherited variation is recognizably discontinuous, though where several genetic factors are simultaneously involved apparent continuity may result. Genetic discontinuity may be further obscured by non-genetic continuity.

An example of apparently continuous inherited variation, where an attempt has been made to analyse the factors involved, is that of the inheritance of " mixed broodedness " in *Limnæa peregra* (Müll.) (Diver and Andersson-Kottö, 1938). Certain sinistral strains were found to be characterized by a capacity to produce occasional odd dextrals which were genetically similar to their sinistral sisters (Diver *et al.*, 1925; Boycott *et al.*, 1930). Since in the type of inheritance (delayed inheritance) operating in this case the brood and not the individual is the unit of observation, the " phenotype " considered was the proportion of odd dextrals in each brood. It was found that this might range from 0 to over 90 per cent odd dextrals, but that each of the different pure lines only spread over a restricted part of the range. This is a character which is bound to be greatly affected by chance distributions and must therefore be considered in terms of mean values for groups of broods with a common ancestry. Further, tests showed that the phenotype was also liable to be affected by changes in environmental conditions which might appreciably raise or lower the mean figure for a pure line. Allowing for these disturbances it was found that the range of

variation displayed by the stock obtained by Boycott from the Leeds pond might be produced by the simultaneous and cumulative (+ or −) operation of six or seven different genetic factors or genes. This complicated case has been treated in some detail because it illustrates all the ways by which real discontinuity may be converted to apparent continuity—the combined action of several genes, ecological plasticity, and pure chance. Somewhat simpler examples may be found in the variation of shell-size and shape.

Polymorphism.

Polymorphism naturally interpreted means nothing more than a well-marked expression of variability ; but the term polymorphic is often restricted to those species in which several distinct forms or phases occur together in the same population, or at least in the same area. In this restricted sense, therefore, it would not be correct to call a species polymorphic which only exhibited continuous variation whether in the same population or in a series of populations showing a progressive change—a condition for which Huxley (1938) has proposed the convenient term " cline ". *Cepæa* may obviously be referred to as polymorphic in respect of shell-colour and pattern ; while the term would be inappropriate to *Limnæa peregra* which, though capable of great variation from population to population in shell-shape, texture, and size, seldom contains two or more distinct forms in the same colony. As has been shown in the preceding subsection, in the absence of detailed genetic analysis it is often extremely difficult in practice to draw any precise line between continuity and discontinuity ; and in so far as polymorphism is restricted to obvious discontinuity it does not serve to classify a distinct set of facts and is apt to be misleading unless used purely in a loose descriptive sense.

Many butterflies show marked seasonal dimorphism as a direct response to external conditions, while others are dimorphic in respect of hereditary mimetic forms. Many snails (*Partula*, *Limnæa*, etc.) are dimorphic in respect of coil—an obligatory discontinuity, since there is no viable intermediate (though see Boycott *et al.*, 1930, and Boycott and Diver, 1930)—but this dimorphism may be either genetic or the result of accidental abnormality. Most of the species that are usually called polymorphic have one common character—a display of obvious and fairly sharp variation in colour and pattern ; but to differentiate them from less showy species may be most deceptive from our point of view because it tacitly conveys the idea that the former display more variation than the latter, which may not in fact be true.

An obvious attribute of a polymorphic species is that one or more characters may each occur in several states. In terms of our concept of variability this means that the characters concerned will be those represented by the large peripheral spherules of Fig. 1, that is to say, relatively superficial characters. Sudden gross changes or small changes in the more vital (central) characters throw the organism out of its limited field and so fail, usually at a very early stage in cell division; cf. the heavy egg mortality of over 90 per cent described by Boycott *et al.*, 1930, in certain strains of *Limnæa peregra*. Less disturbing changes may succeed in the sense that a few individuals will survive to maturity; but these, *ex hypothesi*, will show an impaired vitality and selection will operate heavily against their perpetuation in natural populations. From this it follows that polymorphic displays must be restricted to those characters which can vary, or to that degree of variation which can take place, without appreciably upsetting the internal adaptability of the organism; or if they do, they must presumably be protected from selective elimination by some genetic mechanism or external factors which are sufficiently powerful to compensate for any loss in functional efficiency; cf. Fisher (1930*a* and *b*), who further restricts the term polymorphic to cover only those cases where a balanced mechanism of this type is in operation.[1]

Though the possible colour-pattern phenotypes in *Cepæa* run into very large numbers indeed, the number of actual characters or spherules involved is only about six, the ground-colour of the shell, the number of bands, the order in which the bands appear in ontogeny, the width of the bands, the pigmentation of the bands, and the pigmentation of the lip. Each of these characters has a number of distinct expressions or states which would be represented by a group of dots within each of the six spherules; and the swarm of phenotypes is merely due to the combinations that each particular expression can make with the various expressions of the other five groups. There are many other peripheral spherules of variability that have not been considered at all in this case of "polymorphism"; and the only difference between *Cepæa* and *L. peregra* is that the latter has no banding and the pigmentation of its shell is not apparently the product of the same chemical constitution which in

[1] Since this was written I have kindly been allowed to see the proofs of a paper by Ford (1939) in which polymorphic variation is lucidly discussed and analysed. He follows Fisher in restricting the term to the cases of which the essential feature is that the ratios of the different forms in a population have attained a relative stability through balanced selective agencies. He goes on to discuss the different types of variation that may present a superficial similarity with polymorphism, and emphasizes the need for critical examination of all such cases.

the former is capable of producing a series of distinct colours. On the other hand, the group of characters which acting together are responsible for shell-shape seems far more variable in *Limnæa* than in *Cepæa*.

Parallel Variation.

It is a well known fact that the variations seen in a particular species are often closely paralleled by those occurring in a related species. On the whole this parallelism tends to be most pronounced in those species which are most closely related and to decrease as the degree of divergence from a common stock increases. This relationship cannot be pressed too far in respect of individual spherules of variability but is applicable to the whole sphere, as any detailed study of closely related species will show (cf. Diver, 1939). The variability of a few characters may remain much the same throughout a family or even an order, but that of others may be appreciably changed outside a very small group of species or may even be diagnostic of a single species. This genotypic parallelism in variation, which is the product of a similar physico-chemical constitution, must not be confused with the phenotypic parallelism not infrequently observed between certain characters of species so widely separated as to belong to different orders, such as the close but superficial resemblances that occur between the Syrphids (Diptera) and bees or wasps (Hymenoptera).

Phenotypic parallelism may be defined as the production of a similar appearance by different means; and since this is a wide-spread phenomenon which may even be observed within a genus, it is by no means easy without experimental analysis to determine to which type any particular resemblance should be referred—though phenotypic resemblances would not generally be expected to show a strictly parallel range of variability. An extremely pretty example of this which has been worked out by Ford (1938, pp. 51–3) is the two different methods by which the white and yellow pigments of the butterfly genus *Papilio* are produced. The genus is divided into three sections on rather obscure morphological grounds; but the species in two of these sections were found to manufacture their own pigments ("pterins"); while those in the third section, though still capable of making pterins, seldom do so but produce a similar effect by using anthoxanthins which are plant pigments derived from the larval food.

The simplest example of genotypic parallelism is again the genus *Cepæa* in which practically every phenotype known in *hortensis* finds a parallel in *nemoralis* and a similar parallelism

occurs in their ecological ranges of tolerance though in both aspects, as would be expected, with a slight change in emphasis. There is an obvious though less marked parallelism between *Cepæa* and *Helix* (*sensu stricto*). In *H. aspersa* and *H. pomatia* L. similar types of banding and band pigmentation are to be found; and in the former at least a corresponding colour range, though much obscured by suffused brownish pigment, can be traced. *H. aspersa* shows an additional type of marking not displayed by the other three species but which may possibly be paralleled in *Arianta arbustorum* (L.). Another group of markings is found in *Euparypha pisana* (Müll.) which may be similar to those of *Helicella* and *Cochlicella*. Direct observational studies comparing, for instance, the ranges of colours shown by different species may well point the way to biochemical experiments and genetical possibilities of considerable evolutionary interest. For a case in which a similar parallelism has been traced by genetical methods reference should be made to the work of Sturtevant and Tan (1937) who compare *Drosophila pseudo-obscura* and *D. melanogaster*.

In terms of our concept of variability these facts readily fall into place. The factors that may initiate a progressive decrease in interbreeding between two parts of a species population (leaving out of account for the moment the "accident" of geographical separation) must in themselves be relatively unimportant to the successful functioning of the organism as a whole. A slight variation in habitat preference may lead to ecological isolation, in courtship habit to mating preference, in genital structure to mechanical isolation, or in chromosome morphology to genetic isolation. The constitutional changes that are responsible for these incipient barriers are unlikely to change materially the germ-plasm as a whole. In the slow process of time if the inability to interbreed becomes more pronounced other differences, which, because of these barriers will not be freely distributed from one group to the other, will tend to accumulate, but these also will be mostly superficial changes effecting no more than slight alterations in balance. In other words, in those cases where evolution proceeds by the slow differentiation of two or more non-interbreeding stocks, races, subspecies, and finally species, from a common interbreeding ancestral population the end products will not greatly differ in their biochemical make-up. If, for convenience, we represent our spheres of variability by irregular circles we should in fact expect to find that the circles of two closely related species almost entirely overlapped. That is, though the circumferences might seldom be coincident, the one extending beyond that of the other in some places while receding behind it in others, most of

the area would be common to both and the shift if any of the central core should be very slight. Individual spherules may show less or more variation (fewer or more dots), or might change their variability (size) if the biochemical changes were of such a nature as to permit a lesser or a greater number of chemically stable states. A slightly different but essentially similar picture could be drawn for the cases in which a new species is born suddenly, e.g. those reported in plants where, in a lucky hybridization between two species, the chromosome complements from each parent are doubled and a new balance is struck which will not be swamped by inter-breeding with either parent.

Evolutionary Trends.

We have so far considered the core of least variable characters or smallest spherules as the centre; but from an evolutionary point of view this is not quite correct. Such characters could, *ex hypothesi*, only change very slightly and slowly, so that throughout a genus or even a larger category they might remain substantially the same. The true evolutionary "centre", which marks the general trend of the species and enables the taxonomist to separate the specific entities in a genus, is the centre of balance between all the interacting variables. The different variants which will tend to collect in two stocks that have ceased to interbreed freely will shift this centre from its original locus and so in time give rise to the divaricate structure by which evolutionary trends are usually represented. The central core would then be expected to lag behind the evolutionary centre, and in the absence of new adaptive variants could only follow it to the extent of its inherent adaptability. As the distance between these two centres increases, the antagonism between the central core and the evolutionary centre will grow and the former must exercise a selective control over the latter if the species is to remain a successful working unit. Three possibilities may now be envisaged. The evolutionary centre may still move but its movement will be restricted to the area within which by mutual adaptability reasonable harmony may be maintained, and this state will continue until some adaptive variant in the core opens up a new field. If a combination of circumstances—changed environments, external selection, mutation pressure, heterogonic growth, etc.—forces the species outside these limits of safety, the beginning of extinction is in sight. Lastly, such an efficient stable balance may be reached between these two forces that the species remains virtually unchanged through many millions of generations and unaffected by vast secular changes

in the environment. Species may be found among the ants (Wheeler, 1913), which apparently have continued as recognizable entities at least from the Lower Oligocene to the present day, others may be far more archaic but it is difficult to be certain from fragmentary fossil evidence.

Relative Rates of Development and Growth.

The differences that most often enable the trained systematist to separate two close species are very slight changes in proportions which may seem negligible in themselves but which taken together give a clear though indefinable resultant. Since this is seldom expressible as a "key" character the importance of its small components tends to be overlooked. What has in reality happened is that the emphasis of some attributes has been varied, and one of the ways in which this change of emphasis can readily be brought about is by a differential variation in rates of development. The molluscan shell is excellent material for the study of this type of variation because the story of its ontogeny is written on the successive whorls. Characters, which in a homometabolous insect can only be seen as it were in cross-section with no hint of the course of their development during the pre-imaginal phases, can often be traced on the snail-shell in detail. The simplest example of this is the behaviour of certain ground-colours in *Cepæa.* Pink is a normal dominant to yellow, that is the F_1 hybrid snails from a cross between a pure pink and a yellow will bear a recognizably pinkish shell from birth. But this statement is not true of all types of pinks. Some are very late in making their appearance, so that though the colour of the last whorl in the F_1 hybrids is pink the apical whorls are pure yellow. For the first two or three whorls the young are indistinguishable from pure yellows; by the end of the third whorl the yellow becomes suffused with a slight pinkish flush which steadily increases on the new shell as it is laid down (but does not affect the older whorls) until it reaches its full strength and completely masks the yellow. This was very clearly demonstrated in some crosses made by Stelfox (unpublished). The reverse process is traceable in a few natural populations in which a strong pink develops very early and then dies away during ontogeny to give a shell which has a deep pink apex and a pallid last whorl. Another example is the variation in the time at which the bands make their first appearance on the shell. The different bands may vary considerably in respect of this attribute, a fact noted by Lang (1904) in his experiments, and individual bands may sometimes be so late as only to appear as a dot just

before lip formation. Others may even be, as it were, pushed off the shell altogether, that is they fail to appear at all because their time of appearance has been so retarded in relation to general development that growth is terminated before they are due. A general delay of all bands has been examined genetically by Diver (unpublished) in *Helix aspersa*.

These variations are purely superficial and of no evolutionary or taxonomic value, but they serve to illustrate the much more complex changes that may take place in the relative times at which the various characters concerned with shell shape produce their maximum effect upon development. The construction of the gastropod shell is governed by a group of factors, and changes in their co-ordinated behaviour will produce those subtle differences which make, for instance, the whorls of *C. hortensis* slightly more round-shouldered than those of *C. nemoralis*. Other aspects of differential growth rates in the shells of molluscs have been considered by Huxley (1932, particularly pp. 154–163); and there is scope for much work in this neglected field of variation.

Geographical, Ecological, and Physiological Variation.

These several aspects of the problem of variation have received little attention in regard to mollusca, but for a general consideration of geographical races reference should be made to Rensch (1929 and 1938) and Dobzhansky (1937). All three aspects are discussed by Robson and Richards (1936). The formation of marked geographical races does not appear to be a general phenomenon in gastropods though the large Irish and Pyrenean race of *C. nemoralis* is an example of it; but the results of geographical isolation on a small scale are well shown in several studies, particularly those of Crampton (1916, 1925*a* and *b*) on *Partula*. A complicated and remarkably interesting case is that of the species of *Patella* investigated by Fischer-Piette (1938).

The delimitation and comparison of recognizable races is only one type of inquiry into geographical variation, and no sharp line of demarcation can be drawn between the isolated race and the small natural population or colony, though the end terms are quite distinct. "Geographical race" usually carries the implication that the population in a given area is distinguishable from the rest of the species population in respect of one or more characteristic attributes which are not found elsewhere. Such a race may taxonomically be considered as a subspecies and need not be strictly isolated in that there may be, and often are, overlapping zones in which both types with intermediates occur. If the distribution of individual

variants is studied it may be that one variant, which alone would form an insufficient basis for the recognition of a subspecies, will be found to have a geographically restricted range. Such may prove to be the case with some *Cepæa* variants, but at present the data available are insufficient to sustain detailed treatment. Further, geographical areas can be considered not only in relation to the simple presence or absence of a variant, but also in relation to the *frequency* of that variant in the population. This entails the widespread study of the composition of natural populations, which has only been attempted in a few instances. Work on both these lines is sorely needed, and such facts are of the highest importance in the formulation of our ideas on the mechanisms of evolution.

The terminology applied to ecological variation is not in an altogether happy state. "Ecological race," "physiological race," "biological race," "ecotype," and other terms have all been used rather indiscriminately. Whatever may be the names that are finally adopted for them, there are several distinct concepts to be included under this general heading. We must first determine the variety or range of conditions which one species as a whole will tolerate (tolerance-range), and whether this range is quite the same for all parts of the species population or whether certain areas of population have wider or narrower ranges. *C. hortensis*, for instance, does not occupy sand-dunes in England and Southern Scotland, but in the northern half of Scotland it is found in this type of habitat (Oldham, 1929*b*; Boycott, 1934). In a case of this sort the distinction between the "geographical" and the "ecological" race tends to become a trifle blurred. Secondly, there is the possibility of an association between a particular form and a particular set of conditions, an example of which is the suggestion that the larger flatter forms of *A. arbustorum* tend to be restricted to lowland populations, while the mountain form is smaller and more conical. This type of association may be of at least two kinds, either it may be a direct non-genetic response to the external stimuli of the particular environment, or it may be brought about by the operation of selection on the genotypes existing in the population, some of which may be slightly advantageous in one set of conditions and disadvantageous in another. Thirdly, a particular variant or correlated group of variants may be associated with a habit rather than a habitat—a different food, a different type of behaviour, or in a parasitic organism a different host. It is to this type of variation that the terms physiological and biological race are generally applied; and again there are two possible types, the direct non-genetic response of an adaptable or tolerant organism and the genetic variation which makes the adoption of a particular

habit preferable to a particular variant. This type of association may give the superficial appearance of either an ecological or geographical race depending upon the manner in which the means of satisfying the habit are themselves distributed, and the closest analysis will often be necessary before it can be said with any certainty what are the factors which govern the distribution of a variant.

The Classification of Variation.

The foregoing subsections indicate that several methods might be employed in classifying variations ; but none of the categories which have been discussed is clearly demarcated or founded upon principles which when applied lead to a natural arrangement of the facts. Variation has a fundamental relationship to evolution, for the mechanism of evolution must depend upon the production, retention, distribution, and utilization of variations. This implies that a valid distinction can be drawn between those variations which can and those which cannot be transmitted from generation to generation. Though the latter group has often been treated as one, under the general heading of fluctuations, a further division of it seems called for. Some of these variations, though not transmitted in the genetic sense, do persist through a series of generations but only so long as the causes which evoke them themselves persist ; while others are not the product of a persistent or general cause. We may therefore broadly group all variants into three categories in accordance with the nature of the immediate cause or stimulus that gives rise to them.

(1) Variants that are the product of internal genetic or inherited changes in the individual.

In this case a particular morphological or ecological difference is the outward and visible sign of some obscure biochemical or physiological change. These changes are themselves of several kinds, each of which plays its own part in evolution, but a consideration of their nature, and the nature of the stimuli which provoke them, takes us into the field of cyto-genetics and outside our present purpose (for a general statement see Dobzhansky, 1937).

(2) Variants that are the product of external environmental stimuli acting directly and generally on the population but without provoking any genetic disturbance in individuals.

The range of variation included in this category measures the extent to which an organism can directly respond to such generalized environmental pressure. To distinguish this from genetic or

inherited variation it is convenient to refer to it as the ecological plasticity of the species. The operative stimuli are usually more or less persistent (edaphic, climatic, and biotic factors), or at least show periodic recurrence (e.g. seasonal changes). The persistence of such variants through a number of generations indicates the continued application of the appropriate stimuli during the impressionable periods of development; though in certain cases ("dauermodifications", see Goldschmidt, 1938) somatic modification may persist for several generations after the initial stimulus has been withdrawn. Obviously, the same stimulus applied to different genotypes may elicit different responses so that a population which is genetically heterogeneous may also be heterogeneous in respect of this type of variation. I do not propose here to discuss the possible relationship between environmental stimuli and the production of genetic changes.

(3) Variants that are the product of non-persistent or "accidental" stimuli, whether internal or external, acting on the individual.

These are accidental in the sense that they are not due to the general action of the genetic or ecological background, but are irregular chance occurrences affecting individuals only. The following will serve as examples of the two types covered by this category: internal errors of development leading to *abnormalities* or *monstrosities* (e.g. scalariformity and in some cases inverse symmetry); external factors, such as individual deficiency or excess of food leading to *fluctuations* in size. This category of variants would alone seem to have no evolutionary significance; but nevertheless it is necessary, in order to sort them out from the other types, to be able to recognize such variants and to measure their range of expression.

Varietal Nomenclature.

The above considerations clearly have important bearings on the taxonomic treatment of varieties. It would hardly be disputed that varietal nomenclature has been allowed to get into a chaotic state, and this is primarily due to the neglect of the study of variation and the consequent absence of any basic scheme of treatment. Each of the above three categories demands its own system of nomenclature, but the difficulty immediately arises that the same phenotypic effect may be produced by all three types of variation and it is often hard to say in which category any particular phenotype should be placed. A good example is to be found in shells of unusual

size or texture which might as well be a genetic product, an expression of ecological plasticity, or a mere abnormality, and only a knowledge of the population from which each came might enable us to place it correctly. Goldschmidt (1938) discusses the term "phenocopy" which he had earlier proposed for those non-genetic forms produced experimentally which are phenotypically similar to known genetic mutants. Since the same relationship is found in nature there seems no reason to restrict this useful, though etymologically bastard, word purely to experimental products. An isolated sinistral montrosity in *Limnæa* would thus be a phenocopy of genetic sinistrality.

Molluscan systematists have differentiated one of the types belonging to our third category by prefixing the Latin name with "monstrosity" instead of "variety". If any name is required, which I dispute, this is a reasonable distinction; but it is a pity that the same name has not been applied to the same phenomenon in each case (e.g. *sinistrum* and *sinistrorsum*, *scalare* and *scalariforme*). The difficulty of distinguishing between "monst. *sinistrorsum*" and the true "var. *sinistrorsum*" will be seen from the discussion in Diver *et al.* (1925, pp. 193–6, though the genetic interpretation put forward here is incorrect, see Boycott *et al.*, 1930, and Diver and Andersson-Kottö, 1938), and the latter term should be applied only to those cases where a genetic basis is hardly in doubt. There is no evidence from natural populations or from such attempts as have been made to breed from wild scalariform shells that this condition is other than monstrous in nature. But Boycott and Diver (1930) showed that in the *Limnæa* cultures there were indications that scalariformity or scalarescence might be inherited; and that in this respect it differed from the other monstrous forms (flats, half-flats, and squats) which were the product of an inherited tendency to produce abnormalities and not themselves genetic variants. The other types of abnormality and fluctuation belonging to this category have fortunately not so far been distinguished as such by Latin names, largely no doubt because most of them are phenocopies of true genetic variants; and care should be taken in recording distributions to distinguish, by means which will be discussed later (p. 134), between the phenocopy and the variety. It would seem advisable as a general policy in future to abandon the use of Latin names for all types of variant in the third category.

The second category is the one in which perhaps the greatest need exists for a carefully devised system of nomenclature, though the problem is not so pressing in mollusca as in some other groups. These variants also are mostly phenocopies of genetic variants and as such need to be distinguished from the varietal names that

may be applied to the latter. The problem is one that largely concerns the ecologist, but unless the taxonomist is prepared to collaborate, ecology and taxonomy cannot derive the mutual benefits which are essential to the successful progress of both disciplines. Various terms have been proposed, such as biotype, ecotype, ecophene (for definitions and other terms, see Carpenter, 1938), to cover different categories; but they have been used in various senses and usually connote genetic as well as ecological differences (cf. the work of Gregor, 1938, who has studied and named several ecotypes in the sea plantain, *Plantago maritima* L.). A satisfactory scheme for describing the forms that can arise as a result of ecological plasticity has yet to be put forward and it can only now be said that it would be as inadvisable here as in the last category to apply Latin names that would come within the ambit of the international rules of nomenclature.

The first category is the only one to which varietal names can properly be applied; but here another type of difficulty arises. Are such names to be attached to variants that are the product of a single gene difference and, if so, what is to be done with a form that displays the result of several such differences simultaneously? In a species like *Zonitoides excavatus* (Bean) it is obviously convenient to use Jeffreys' var. *vitrina* to differentiate the albino form which is the only named variant of this species given by Taylor (1907–1914). But how is this principle to be applied to *Cepæa* which from combinations between colour and pattern alone produces innumerable, complex, but distinct, phenotypes? If each of these is to receive a name, as many of them did during the nomenclatorial excesses committed principally by Moquin-Tandon and Locard (which may be found listed by Taylor), the result is to clutter up taxonomic literature with many hundreds of meaningless and useless names. On the other hand, to affix the name *rubella* to a specimen merely implies that in respect of ground colour the shell is pink, and leaves all its other variable characters out of account.

It was the recognition of the now obvious and simple fact that the initial step in the analysis of variation was first to consider each variable independently which led Mendel to discover the basic principles of heredity. Modern genetics developed the principle of giving each expression of a variable character a descriptive English name. As analysis proceeded it became possible in some cases to transfer this name from the phenotype to the responsible gene; and the genotypes of experimental strains of *Drosophila* are fully and accurately described to-day by a series of these names each abbreviated to two or three letters. Though a genotypic description can only be attempted for a very few species, the corresponding

phenotypic description can be generally applied. This fact was recognized by Adams (1896) before the science of genetics was born, and in his manual he gave the only proper way of treating the varietal names of *Cepæa* if they are to be used at all. If it is argued that this is an improper reversion to the old polynominal system, the only answer is the replacement of this method by phenotypic description. A shell which might be described as *rubella* + *roseozonata* + *quinquefasciata* + *roseolabiata* is in fact a pink (P) hyaline (hy) five-banded (12345) shell with a self-coloured lip (sl), or P hy 12345 sl. In fact, the forms called *roseozonata*, *citrinozonata*, and *hyalozonata* are all due to the same change—the complete loss of power to form the dark pigment normally laid down in the bands and the pigmented lip, or partial albinism. This results in pink bands on a pink shell, yellow on a yellow shell, and colourless on a white shell, coupled with a self-coloured or white lip. The form *libellula* + *citrinozonata* + *quinquefasciata* + *luteolabiata*, therefore, has the same formula as the last except that P is replaced by Y, Y hy 12345 sl. The full application of this principle to variation in *Cepæa* will be considered elsewhere. The same system can equally well be used to distinguish the two forms of *Z. excavatus*.

The above examples have been confined solely to colour and pattern ; and all other variables, such as shell-shape, texture, and size, have been disregarded. If these are also taken into consideration as they must be, either method of varietal nomenclature (as opposed to phenotypic description) completely breaks down in any polymorphic species. There remains, however, a type of intra-specific variation to which taxonomic principles can properly be applied, i.e. in the delimitation of *races* whether geographical, ecological, or physiological. The term race is here used to mean a population or series of populations that differ from other populations in respect of one or more definable characteristics. These may range from comparatively small and unimportant changes up to those which would be given sub-specific rank. In the few cases that have been examined these races are the product not of single gene differences that within a population interchange freely with their typical states, but of a series of correlated genetic changes. Examples of such races are to be found in some of the lake forms of *L. peregra* and in the geographical races of *C. nemoralis*.

The Analysis of Variation.

Methods.

The two principal methods by which variation may be studied and analysed are the experimental and the observational. The full

analysis of the variation of a particular species must require some experimentation for which many conchologists have neither the time nor the facilities. But it is perhaps not generally realized that the experiments which are sufficient for the classification of variation (as opposed to the detailed analysis required in genetic research) are often of quite a simple nature. On the observational side there is an unlimited amount of interesting and valuable work open to any field naturalist who is prepared to collect his data on the simple method of making *random samples* of natural populations or colonies. The essence of the random sample is that there should be no selection of certain specimens to the conscious exclusion of others ; and it should be restricted to a locus or station which is ecologically homogeneous (Boycott, 1919). Factors that must be considered in determining this homogeneity are clearly set out by Alkins (1928, p. 51 ; and see also Boycott, 1920). What constitutes a natural population will be considered in a later section (p. 125). Material collected in this manner admits of statistical treatment, and most of what we want to know can be found out by applying a few simple tests. Which tests should be applied in particular cases depends upon the nature of the variant considered. Some characters, such as length, breadth, volume, etc., can be directly measured. Boycott (1928) has fully and lucidly described the methods of measurement, the statistical treatment of the results and the kind of answer that may be obtained from this class of continuous variant. Nothing would be gained by an attempt to summarize his statement here. There is, however, another group of characters, such as colour and pattern, which display discontinuous variation, and are not so readily susceptible of direct measurement. But the number of such a variant in any sample can be counted, and expressed as a percentage frequency. In this way its distribution through a series of samples can be compared. The recent work of Fisher (1925) has provided several sensitive and most valuable tests by which this class of data may be examined. Even if this refinement of analysis is not attempted and the data are presented in their crude form, they will be available for those who take their pleasures mathematically.

Examples of Experimental Analysis.

In his experiments on *Arianta arbustorum*, Oldham (1931) used a small high-spired form which probably belonged to a genetic race. Under his experimental conditions the strain became slightly flatter, in circumstances which suggested that this effect was an expression of plasticity (second category variation). But one brood

was composed entirely of scalariform or scalarescent shells which were found to be a pathological abnormality (third category variation), attributable to infection by mites. Boycott and Oldham (1938) found wild *Helix aspersa* with a peculiar wrinkling of the later whorls of the shell. Breeding experiments showed that this also was a pathological abnormality due to some contagious disease.

Oldham (1929*a*) tested, by using normal *A. arbustorum*, the relationship of the thickness of the shell to the presence or absence of lime in the diet and obtained the result that the shells in batches of lime-fed animals were greatly heavier than those of the lime-starved batches, though the size of both batches remained much the same. In 1934 he reported similar results in *Helix pomatia*, *H. aspersa*, and *Geomalacus maculosus* Allman, and further results with *A. arbustorum*. The effects were the same whether the wild population from which the parents were drawn was heavy-shelled or extremely thin-shelled (the so-called var. *tenuis*) ; and he concludes that it is illogical and improper to bestow a varietal name on characters which are entirely referable to ecological plasticity. I have myself reared a normal-sized lime-starved *H. aspersa* which was so thin that its columella broke on removal from the glass of its cage. In contrast to these cases I have found a single thin-shelled snail in a normal population of *H. hortensis* ; whether this was a third category abnormality or a genetic mutant cannot be said. That this type of variation may be inherited is shown by Crampton's (1925*b*, p. 26) observations on two species of *Partula* in Guam. The thick-shelled species, *P. salifana* Crampton, lives in that part of the island where no limestone rock is found, while *P. fragilis* Férussac, which possesses a very thin shell, thrives in the region of calcareous rock.

Robson (1926) and Boycott (1929) examined the keeled and coronated forms of *Hydrobia jenkinsi* Smith. The former found that the keeled form was not inherited and concluded that there was presumptive evidence for regarding it as an expression of ecological plasticity. Since whole populations may be uniformly of the one type it is not an abnormality or fluctuation in our sense, though smooth and keeled forms may also occur together. The latter author had a similar experience with the coronated form, but showed that it had persisted in one locus for at least fifteen years. He was unable to determine what stimuli produced the variant but obtained some evidence that "bad" conditions encouraged its appearance. I now have under examination in a ditch at Studland a population which passes from the smooth form at one end to the coronated form at the other. The solution of this problem is most likely to be advanced by the corporate effort of a number of workers

willing to make a widespread observational study of *jenkinsi* populations coupled with detailed records of the ecological conditions in which each occurs.

Limnæa peregra is an interesting species in that it shows signs of pronounced ecological plasticity—a condition that seems to be far less common in animals than in plants. The members of a single population from a particular habitat are usually uniform in shape and not infrequently differ, often very slightly but characteristically, from the shape prevailing in other populations. But this fact alone is not sufficient evidence that such variation is referable to the second category. In long-isolated and closely inbred populations an identical effect might be produced by the action of selection on genetic mutants. In this case experiment alone can decide. The Leeds population from which Boycott drew his original sinistrals was, in its natural state, a well-grown, large-mouthed form with a short, sharply-pointed spire. Brought into the standard conditions of culture it rapidly became more elongated and smaller mouthed, and in such a way as practically to exclude an explanation based on genetic segregation. On the other hand, Stelfox kindly supplied us with individuals from an Irish population which in shape were sub-involute, high-shouldered, and laterally compressed. They also differed from the Leeds stock in the colour and texture of the shell and in the distribution of body pigment. The whole animal gave the impression of belonging to a strikingly distinct race. These differences proved to be heritable, and the race preserved its peculiarities in their entirety through at least ten generations of culture. When crossed to the Leeds stock, with which it was quite fertile, it was clear that the two races differed in a number of genetic factors of which more than one affected shell shape (Boycott *et al.*, 1930 ; Diver and Andersson-Kottö, 1938). Boycott (1938) later tested twenty-one other wild populations, mostly involute forms from mountain lakes. He found that some of these forms retain their characteristic features in culture and are apparently, therefore, like the Stelfox race, the product of genetic factors ; while others in two or three generations changed, like the Leeds stock, to a more elongate shape. These findings indicate that the apparent tendency of populations in certain mountain lakes to become low spired or involute may in some instances be at least mainly a plastic response to their peculiar environment, whilst in others it is associated with genetic changes directed to the preservation of this form. But these experiments did not exclude the possibility that these changes are in the nature of "dauermodifications". The theoretical implications that might flow from these results are of considerable interest ; and again a

widespread observational study of *peregra* populations in relation to types of habitat is badly needed.

Genetic experiments have been carried out by Oldham and by Diver (both unpublished) on a number of variants in *H. aspersa.* From these it can be said that several colour forms, types of banding and marking, time of onset of bands, and size of shell are heritable first category variations. Lang (1904, 1906, 1908, 1911, 1912) showed that many colour and band variants in *C. nemoralis* and *C. hortensis* are genetic ; but that some band formulæ, e.g. 12045, may not be (see below, pp. 121 and 134). Stelfox (1918, but mainly unpublished) has confirmed and extended these results in an extensive series of experiments which are still in progress. Albinism of the body and of the shell in *Planorbis corneus* L. have been demonstrated by Oldham (1938) to be the product of two single uncorrelated gene mutations. Body albinism occurred as a recessive mutant several times during the experiments on sinistrality in *Limnæa peregra*, and there were indications of the inheritance of pale body colour (Boycott and Diver, 1927 ; Boycott *et al.*, 1930). On the other hand the full dark body-pigmentation which characterized the Leeds wild stock was rapidly lost apparently as a direct response to culture conditions, while the already " wan " colouring of the Stelfox race remained unaffected.

This subsection cannot be concluded without reference to Künkel's (1916) extensive observations and experiments on the biology of a number of common species of slugs and land-snails. The first part of this work is concerned mainly with the absorption and loss of water, and the resistance of various species to drought ; while the second part deals with such general matters as : the development of the embryo, weight and body-size, pigment, sexual maturity and copulation, egg laying, and the length of life. Though the study of variation was not Künkel's object, he has collected a nucleus of fact from which such studies can grow.

Examples of the Observational Analysis of Continuous Variation.

Boycott (1928) gave a number of instances of the application of conchometric methods to the study of variation, and it is not necessary here to mention more than a few later papers. Price-Jones (1930) measured the samples taken by Diver and Boycott from the dune population of *C. nemoralis* at Berrow in Somerset, each sample being taken from a small area, not many yards square, in which uniform conditions prevailed. He found that in each of

three samples that he examined in detail the larger shells were significantly flatter and the smaller shells significantly more conoid. In other words the factors causing individual decreases in size, which are not the product of a general environmental pressure, tend to change the *proportions* of the shell and do not result merely in producing a smaller shell of the same shape as that of normal-sized or larger specimens. This observation on individual variants may be compared with the observed population differences in, say, *Arianta arbustorum*. In this species under certain conditions (e.g. in highland areas) whole populations tend to be both smaller and more conoid, while under other conditions (e.g. in lowland areas) they tend to be larger and flatter.

Crampton's (1916, 1925*b*) monumental studies on the genus *Partula* cannot be summarized here, but many points of interest may be derived from an examination of his detailed figures relating to size differences; and it is clear that such characters may be distributed in the same way as colour types, that is, uncorrelated with environmental differences.

An interesting example of where a mistake in specific diagnosis was revealed by the statistical examination of size differences was that of a large and remarkably uniform population of *Cepæa*. The sample (which was later kindly sent to me by Dr. Alkins) contained 3,747 shells, of which 95 per cent were unbanded and 5 per cent had a dotted third band, 00300. In regard to lip colour, 79 per cent had pigmented lips and 21 per cent white lips, all the latter being unbanded yellows. In regard to ground colour, 75 per cent (2,820 shells) were yellows; and of this figure, 67 per cent were 00000 with pigmented lips, 28 per cent were 00000 with white lips, and 5 per cent were 00300 with pigmented lips. The whole population had been referred to *nemoralis* but measurements made by Alkins revealed that the white-lipped yellows were significantly smaller than those of the other groups. A further collection of about 150 white-lipped yellows was then sent to me alive, and examination of the genitalia revealed that only about 3 per cent were *nemoralis*, while the rest were typical *hortensis*. On shell characters alone no safe separation between the two species could have been made in this particular population.

Alkins (1928) measured and examined statistically a number of mixed populations of *Clausilia rugosa* Drap. and *C. cravenensis* Taylor, and clearly demonstrated that the two species are sharply distinguishable. Though individually the two altitude ranges may overlap to some extent, their diameter ranges hardly ever do so. "Doubtful cases are so rare that the diameter may be used as an aid in the specific diagnosis of single shells." Since the

samples were collected with strict regard to the limits of colonies and ecological homogeneity, the work also provides an excellent illustration of how size variants may be distributed in natural populations.

The Irish lake forms of *Limnæa* (some of which were later bred by Boycott (1938, see p. 116 above)) have attracted the attention of a number of naturalists. Huggins (1918) made a detailed survey of a series of lakes and found that the population in any one lake was all of the same form, but that quite different forms ranging from sub-involute to typical *peregra* might live in adjacent and even communicating lakes. Boycott, Oldham, and Waterston (1932) made a further survey and not only reviewed all the evidence relating to variation in shape, but considered shell thickness, relative size of shell in relation to size of body, number of eggs per capsule, and the anatomy of the genitalia. They also gave detailed descriptions of the habitat conditions in each lake visited, and showed that the different forms have been known to persist without perceptible change in some lakes for periods ranging from twenty-two to ninety-nine years. Some, but not all of this variation, seems to bear an obvious relation to environmental factors, and in other cases, though no obvious correlation is revealed by the available data, there is the suspicion that very fine and so far undetected ecological differences may be the principal agents.

The results of Mozley's (1935) investigation of variation in the shell shape of *Limnæa palustris* (Müll.) and *L. emarginata* Say., in North America make an interesting comparison with the behaviour of *L. peregra* in the British Isles. Mozley finds that in the former species the variation in any one locality tends to approximate to that which occurs over the whole of the territory occupied by this animal; while *L. emarginata* splits up into local forms or races. This he attributes to differences in the distributional structures of their populations. The former occurs in ponds and small lakes which often lie close together and therefore offer reasonable chances of outbreeding; while the latter occupies a relatively rare and widely separated type of habitat which should increase the amount of isolation and inbreeding. If this be the true explanation in the case of *L. emarginata*, it cannot be evoked to explain the comparable behaviour of *L. peregra* in the Irish lakes. On the other hand, it is possible that *emarginata* is comparable to *peregra* in showing a greater ecological plasticity than *palustris* which will tend to obscure, and thus limit the range of its variability. It is pertinent to add that in general terms *palustris* has a much wider range of tolerance than *emarginata*.

Examples of the Observational Analysis of Discontinuous Variation.

The genus *Partula* not only displays much variation in colour and pattern but also contains amphidromic species. The distribution of these variable snails over a wide area of oceanic islands characterized by a number of deep, more or less isolated valleys, in which lie the habitats occupied by most of the species in this genus, provides an almost ideal set of conditions for evolutionary studies. Here, if anywhere, one might expect to find race-formation in all stages of development, even within the confines of a single island. Not only are there pronounced physiographical barriers which may effectively prevent the mingling of neighbouring populations, but also mechanical barriers to out-crossing which tend to separate populations that are predominantly sinistral from those that are dextral. Crampton had the further advantage that he had behind him the careful observations made by Garrett some thirty or more years earlier, so that he was able (e.g. in the case of Moorea, 1925*a*) to examine the changes in the distribution and relative frequency of variants and species that had taken place over a number of years. His detailed surveys and the mass of material he collected are in themselves of primary importance, but as a background for a re-survey in future years they are invaluable.

Island faunas have exercised a great fascination over students of evolution because of their obvious isolation ; but it is not generally realized that natural populations anywhere are seldom continuous over more than very small areas, and, though they are separated by no striking physiographical barriers, these units may sometimes be as effectively isolated from each other as if they were divided by many miles of sea, mountain, or desert (cf. Diver, 1939, 1938*b*). Some of the results that may be obtained from the study of natural populations within the limits of this country have been very briefly outlined by Diver (1932). The distribution of variants in colonies of *Cepæa* has interested many workers, and the following are but a small sample of the papers that might be quoted : Aubertin, 1927 ; Aubertin and Diver, 1927 ; Aubertin, Ellis, and Robson, 1931 ; Boettger, 1921, 1931 ; Diver, 1931 ; Rensch, 1932 (whose figures will also be found tabulated in Robson and Richards, 1936).

The first stage in the examination of this type of variation is to determine on broad lines which are the variable characters (cf. p. 102 above), and then to delimit the different expressions of each of these variables so that any population may be grouped and counted in terms of each expression. In *Cepæa* the ground-colour of all shells is either yellow or not yellow (in terms of a previous definition of what shades will or will not be considered as

yellow), pink or not pink, irrespective of banding, lip-colour, size, direction of coil, or any other attribute. Again a shell is either banded or unbanded, and if banded can be placed under one or other of the various band formulae. In this way each sample can be sorted into a number of groups, and we may then consider how these different attributes are related to each other. We find, for instance, that pink ground-colour is not necessarily associated with a banded or an unbanded condition. Though in certain colonies in which yellow and bandedness are present all the pink shells may be unbanded, in others banded pinks may be more common than banded yellows. Facts of this nature may support the inference that the genes for pinkness and unbandedness are genetically linked (cf. Fisher and Diver, 1934) ; and if it is known that unbandedness is dominant to bandedness it might be inferred that the pink in this case is dominant to the yellow. This type of analysis shows, for instance, that absence of pigment from the lip may be due to two separate causes, the unpigmented lip (referred to above, p. 113), which is due to a general inability to form dark pigment, and the true white lip which, since it may be present with fully pigmented bands, is not the product of any general inability but of a special inhibition.

It is only necessary to look at a few *Cepæa* colonies for it to become obvious that in one colony there may be 90 per cent pinks and 30 per cent banded, while in another, which comes from an ecologically similar habitat there may only be 25 per cent pinks but as many as 80 per cent banded. Such comparative figures may be obtained for each of the main attributes or for any combinations between them. I have since 1920, through the kind help of many people, obtained random samples from over 450 separate colonies totalling well over 100,000 shells. These samples have mostly been drawn from different parts of the British Isles and a wider extension of this survey is much needed, but even within these narrow limits many facts can be ascertained. The preliminary genetical work done by Lang, Stelfox, and others has increased the number of inferences that may be drawn from these data, but the absence of such a background need be no deterrent to the making of similar surveys in other species. The way in which the frequencies of these attributes can be seen to vary from colony to colony is in itself indicative that they are the product of genetic changes belonging to our first category.

Most of the common band formulae are found to be distributed in this way ; but not necessarily all of them. For instance, types 12045 and 12:45 seem to occur sporadically in ones and twos and do not form an appreciable percentage of any colony. The

figures from the Bundoran population of *C. nemoralis* will serve as an illustration.[1] In 45 samples, which together contained 11,499 banded living adults, these forms occurred in 19, or 42 per cent, of the samples and totalled 38, or 0·33 per cent, of the banded living adults. The maximum number in any one sample was 6 out of 664, or just under 1 per cent. In a single sample of 4,710 banded dead shells collected from a "blow-out" 1 shell, or 0·02 per cent, was recorded. These facts suggest that the forms are fluctuations belonging to our third category, but this is by no means certain. Lang (1906) found that when he bred from a pair of 12045 he only got five-banded progeny in F_1 but these experiments were not taken far enough to be decisive.

The 10345 type behaves in a comparable manner but may be much more common. In the Bundoran population it occurred in 36, or 80 per cent, of the samples and totalled 872, or 7·6 per cent, of the banded living adults. The greatest number in any living sample was 154 out of 758, or 20·3 per cent, where all the remaining 79·7 per cent had five bands present, but the highest individual percentage was 25·6 out of 262. The single sample of dead shells comprised 219, or 4·7 per cent. Though this form does not behave like the product of a single gene, its distribution is suggestive of a more complex genetic situation. Similar data for *C. hortensis* can be found in the table of Rensch's figures given by Robson and Richards (1936, p. 97). Here the distribution of these two forms may be compared with that of 10305, which is a known genotype occurring not infrequently in Continental populations of this species.

A simpler case of a third category abnormality is that of the odd sinistral found very rarely and entirely sporadically in almost any dextral species—in *C. hortensis* I have seen one in about 30,000 shells (for further figures see Pelseneer, 1920). But the persistent occurrence of a small percentage of sinistrals in a given population is very probably a genetic phenomenon, as Boycott proved it to be in the case of the *Limnæa* population of the Leeds pond.

In 1914 Boycott (1919) examined a series of populations of *Clausilia bidentata* (= *rugosa* Drap.) in the same neighbourhood, and found significant size differences between some of the populations; and such differences occurred between colonies only half a mile apart. Neither the differences nor the similarities bore any obvious relation to the ecological conditions, a fact which

[1] The Bundoran survey was aided by a grant from the Government Grant Committee of the Royal Society to whom acknowledgment is hereby made.

suggests that the variation is genetic. Ten years later he (1927) re-examined these populations and found that in general the characteristic size of each had been maintained, but that the shells of the 1924 samples were generally and significantly narrower than those of 1914. This fact suggests that ecological plasticity may also play some part. In the meanwhile, in order to test the composition of a larger population within what might broadly be considered as a single ecologically homogeneous locus, he (1920) examined a number of mixed samples of *C. bidentata* and *Ena obscura* (Müll.) from a beech wood. He found significant differences as close as 50 yards apart which again would suggest genetic differences between small inbreeding units of population. But, on the other hand, the variation in size of both species (which were living together up the same trees) ran reasonably parallel—a concurrence which would seem to indicate that this variation was at least in part under the control of fine ecological differences.

Recent unpublished work by Dr. Haworth (which she kindly allows me to quote) on variation in *Pomatias elegans* (Müll.) indicates a rather different type of distribution to that found in *Cepæa*. She has sampled a number of colonies from various types of habitat in Kent and Buckinghamshire, and has been able to sort her material into four principal varieties. The data provide reasonable grounds for supposing these to be genetic; but, unlike *Cepæa*, the frequencies of the four types remain remarkably similar throughout these colonies. The number of colonies so far examined is not great and it is of considerable importance to determine how general this apparent uniformity may be.

Such a regularity of frequency might be brought about if there were complete random mating between the many colonies forming, say, the population of South-Eastern England; but in a snail with the habits of *Pomatias*, which is extremely "choosey" about its habitat and forms sharply defined and well isolated colonies, this cannot be seriously contemplated. There is no evidence that the intervening country between neighbouring colonies (which are often separated by considerable distances) carries even the sparsest distribution of individuals which by mating with their nearest neighbours might supply a thin line of gene-flow (gametic migration); and, though the movement of individuals from one colony to another (zygotic migration) has not yet actually been tested by marking shells, it seems most unlikely that this would be of anything like the order of magnitude required. Since the species is operculate it could not be accidentally transported in quite the same way as Aubertin, Ellis, and Robson (1931) have shown to be the case in *Cochlicella acuta* (Müll.); though the presence of an

operculum offers another method of holding on to thin objects. Added to this, the species is largely subterranean in habit, and seldom climbs like *C. acuta.* Accidental transportation may well be a factor in the founding of *new* colonies but it is difficult to conceive of it as an effective agent in zygotic migration between existing colonies.

Another type of explanation may be sought in the possibility that the selection pressure, despite the ecological dissimilarity of the various habitats, is reasonably even over the whole area under consideration, and that the proportions found by Haworth represent the balanced optimum for the four varieties (for a discussion of this problem see Ford, 1939).

Another possibility must be born in mind. The variants in *Cepæa* are very numerous and mostly behave as if they were primarily the product of single gene differences which in several cases appear to be members of an allelomorphic series. If new colonies are founded by the migration or transportation of only one or two gravid snails, a number of phenotypically important genes present in the parent colony may be entirely omitted from the foundation stock of the new colony and they could only be introduced by fresh migration or mutation. If, on the other hand, the variants under observation were not controlled by single genes but were the product of several genes and modifiers acting in combination, a much more complex genetic situation arises. The absence of one or two modifiers, though producing fine phenotypic differences, is unlikely to affect a broad classification into so small a number as four principal varieties. Greater differences might be revealed by a fine analysis of the variation, but, on the other hand, the gene complex might be of such a nature that the chances of producing striking differences from colony to colony were very greatly reduced.

These considerations apply also to some extent to the case of *C. acuta* (Aubertin *et al.*, 1931). These authors recognized some ten phases of the banded and flammulate patterns but only considered their material in three broad groups: unbanded with or without flammulae, banded, banded and flammulate. The figures for the nine Sussex colonies (tabulated at p. 1042 of their paper) do not show striking differences in the frequencies of these three groups, though in a certain number of cases the differences are statistically significant. However, the odd collections from geographically wide areas (p. 1036) do show that the frequencies in the British populations differ from those in France and that those from Southern Europe and North Africa are markedly distinct from both the other two areas. Six of the Sussex colonies were re-examined

after a period of years (two to eight), and in three the frequencies of the two latter groups showed some instability. These authors found no suggestion that the frequencies of the different patterns were associated with ecological differences and concluded that "The random development of genetic differences in the constitution of colonies at their inauguration seems to be the chief agency at work." It seems probable that, if the variants had been more finely grouped, the similarity of their type of distribution to that of the variants of *Cepæa* would have been increased. In contrast to this, the distribution of melanic forms appears to have some relation, though probably a very complex one, with environmental factors.

The Structure of Natural Populations.

Distributional Structure.

Any study of the distribution of variants within a species is obviously dependent upon the way in which the specific assemblage as a whole is distributed in nature. Although all the individuals composing a species may potentially be capable of interbreeding and producing fertile offspring, to what extent in fact does such random mating occur throughout the whole geographical area of occupation? How far are we justified in treating a species as a single interbreeding unit, and if it is not a single unit what are the natural units we must examine? In other words, we must first gain some idea of what may be called the *distributional structure* of a specific assemblage (or total population of a species).

It is evident that in any land or freshwater species of snail the populations which live in the British Isles are most effectively isolated from the Continental populations of the same species. Migration is impossible and the chances against transportation are very great. Other kinds of physiographical barrier produce an equally or only slightly less efficient isolation. Such features, therefore, form a major network which breaks up the species into a number of discontinuous groups between which germinal interchange is at the best extremely rare. Within this major network further disruptive factors come into play. It is most unusual to find any considerable stretch of country which is not in fact a fine mosaic of a number of quite distinct habitats (cf. Diver, 1938*a*). Even in areas which give a superficial appearance of uniformity close examination will usually reveal many fine shades of difference.

Common species are characterized by having a wide range of

different habitats that they will tolerate (tolerance range); for instance, *Clausilia rugosa* will live in such different conditions as those obtaining in a stone wall or a beech wood, and *Cepæa* may occupy marshes, woods, downs, hedgerows, or sand-dunes; but, even so, quite small differences which often cannot be detected without the closest analysis will apparently determine the limits of a colony within some particular habitat. Even the commonest species does not occur everywhere; and all collectors are aware, if only subconsciously, that any specific assemblage is but the sum of a vast number of small discontinuous natural populations or colonies. A colonial habit is not, as some have assumed, the peculiar attribute of a few species, but is a general fact, though in some species it is far less obvious than in others.

The questions that must be answered before we can be said to know the distributional structure of a given species (e.g. the degree of discontinuity, the range of numerical size, the amount of individual or mass movement) have been considered elsewhere (Diver, 1939), and all that need be said here is that next to nothing is known about these matters, though they have the most important bearings upon the mechanism of evolution. For instance, Wright (1939) has shown that numerically small inbreeding units provide the most effective structure for rapid random differentiation.

We thus see that the unit of observation must be the natural population or colony, and in considering the distribution of variation the greatest care must be taken to keep samples strictly within the limits of a single uniformly populated locus. Occasionally it will be found that an apparently continuous population covers quite large areas, as does that of *C. nemoralis* on the dunes at Bundoran and Berrow; but a closer examination shows at once that such populations vary considerably in density from point to point and it would be quite unsafe to assume that the frequency of the phenotypes will be the same in two such areas of density even though they are only separated by quite a narrow belt of sparser population. In addition to studies of variation in polymorphic species, work is badly needed on the way in which the populations of any species are distributed in given areas.

Breeding Structure.

The determination of the distributional structure is only the preliminary clearance of the ground. If the evolutionary mechanisms at present in operation are to be revealed, we must also know what may be called the *breeding structure* of populations, and how

this structure varies as between different species or perhaps between populations within a single species.

Observation indicates that individual snails do not normally move very far from their chosen resting-places and in some species certainly return regularly after feeding to particular spots. This suggests that natural populations are in the main closely inbred, and that it may not be safe to assume random mating throughout even a single population. The patchy distribution of genotypes within a colony lends strong support to this view; statistically significant differences in frequency may be found within a few yards (Diver, 1939). In suitable circumstances such as those found at Bundoran it is possible to guess, by using one of the genetic characters as a marker, how much out-breeding takes place. The band type 00300, which behaves as a genetic unit, was in 1924 only present in a part of this vast population. If the frequency of its occurrence in our samples be plotted on a map of the dunes, it becomes clear that there is a single centre of high frequency (probably the site of a fairly recent mutation since at this particular spot the chances of accidental introduction seem extremely remote) surrounded by a series of decreasing frequencies. If lines of equal frequency, which may be called "isomors", are drawn on the map, it can be seen that the spread of this gene through the population has followed the line of most continuous density. It had, in fact, spread in an elongate tongue along a "valley" and had not then reached parts of the population which though geographically nearer to the centre of origin were only very poorly connected with it. In the absence of such fortunate circumstances as these, it is possible to introduce a suitable genetic marker into part of a population which can be re-examined at intervals to determine whether, and if so how, the new phenotype is spreading. So far as I am aware, this has not yet been attempted with snails.

Since evolution must in the long run depend upon inherited characters, the following factors must operate: the rate at which mutations occur, which can hardly be measured in nature but may sometimes be estimated; differential survival and reproduction rates, which in a few cases can be directly observed; and what has been called the "gene-flow", which is exemplified by the case just given. These factors determine the proportions in which different genes (using the word gene in a wide sense to cover any genetic differences) are present in populations; and the variation we see in a population is the resultant of the interaction of gene frequency and ecological plasticity, that is the extent to which environmental factors have modified the phenotypic expression of the genes, coupled with such third category variation as may be present.

Gene-flow may be brought about in two ways. First by the voluntary or involuntary movement of individual snails (zygotes) from one population or one part of a population to another, that is by zygotic migration. In this way a particular gene or genetic complex may be introduced into some population from which it is absent, or may be spread through a population. When a single gravid snail, or several snails, move or are moved from a population to an unoccupied habitat where they are no longer in mating contact with their parent population and there succeed in founding a new colony, the genetic variants this colony will contain are obviously limited to the genes carried by this foundation stock; that is, the variants in the new colony will be the same as those in the parent colony except that some of the latter may have been left behind. The only way in which new variants can occur is by further zygotic migration or by mutation. On the other hand, the frequency of the variants in the developing colony will be controlled by a more complex set of factors. The primary factor, of course, will be the constitution of the foundation stock in which the frequency may be quite different from that in the old colony; but, apart from the effects of new migration and mutation, this new basic frequency can in time be completely changed by the cumulative differential effects of random elimination (Wright, 1939) as modified by any positive or negative selective forces that may be in operation in the new habitat.

The second method by which gene-flow is brought about is by the transference of sperm (male gametes) in the ordinary course of random mating, that is by gametic migration. From such observations as I have been able to make, mating between snails does not appear to be selective, but depends on the chance meeting of two sexually active individuals. These meetings occur during the ordinary periods of movement and feeding and therefore are most likely between snails that share the same feeding grounds. If a snail lays its eggs in the vicinity of its normal resting-place and the young do not scatter very widely when they emerge, and what evidence there is suggests that these assumptions are reasonable, the chances of inbreeding are considerable. If a single hermaphrodite snail has acquired a new gene which is neither beneficial nor deleterious to its possessor, this gene will stand a fair chance of being handed on in the course of two or three generations to a certain proportion of the joint progeny of the matings of this snail with those that shared its feeding-ground and, if it so establishes itself, will tend to spread throughout the colony until a condition of approximate equilibrium is reached.

How this occurs may be illustrated by considering an ideally

simple condition. Suppose an adult population, which is numerically stable, of a hermaphrodite cross-fertilizing species which only mates once ; then each individual is replaced in the next generation by a single child. (It should be noted that in a stable population the number of young produced per parent is immaterial provided that it exceeds the minimum which in the circumstances of the particular species is sufficient to secure that one shall survive to sexual maturity. The surplus is wiped out by the increased effect of the overcrowding factor upon the infantile death-rate.) Suppose, further, that each adult confines its normal movement to a circle of one yard radius, and that the population is evenly distributed so that each circle of movement touches four other circles ; then there is an equal chance that the individual carrying the new gene will mate with any one of its four contiguous neighbours but no chance that it will mate with any other snail. In these conditions there is a 50 per cent chance that in the next generation the new gene will be present in one of the contiguous circles and an equal chance that it will again be represented in the original circle, which gives a 25 per cent chance that it will be present in both the original and a new circle ; but there is also a 25 per cent chance that it will be lost altogether and a 50 per cent chance that it will only survive in one circle. If it succeeds in surviving in two circles its chances of being lost altogether in the subsequent generations are considerably reduced and the way is increasingly open for a slow but irregular spread through the population until the breeding limits of the colony are reached. Outside these, only zygotic migration will succeed in passing the genes descended from the original gene into another colony. Other aspects of this problem are fully and clearly discussed by Dobzhansky (1937), but one fact which emerges from the work of Fisher and Wright is that this type of random elimination or fixation of genes is a dominant factor in controlling the genotype of a natural population.

Obviously the ideal conditions postulated will not exist in nature but they serve to show how important it is to find out for different species what are the factors that may cause irregular clustering of individuals within colonies, what is the average distance of individual movement, how sexually active individuals meet, where the eggs are laid in relation to the resting-place of the parent, what are the habits and movements of the young, and what is the normal size and size-range of discrete populations. In *Cepæa* and other large species considerations of cover often break a population up into a number of small clusters, e.g. scattered bushes of *Rubus* surrounded by closely-grazed turf, tufts of *Psamma* on sand-dunes, or, as at Berrow, tufts of *Iris* in close turf. Some

of these latter which contained clusters of about twenty to forty snails were individually examined and even on these small figures there were suggestive differences between them in respect of the frequency of certain phenotypes, which would indicate inbreeding within tufts and some restriction of gene-flow between them.

The Study of Natural Populations.

The Spatial Isolation of the Unit of Population.

In the preceding section we set out to inquire what was the natural unit of population upon which studies of variation should be based; and it was shown that physiographical and ecological factors, coupled with limited powers of movement and a widespread individual conservatism or tendency to "home", result in breaking up the total population of a species into a number of small natural populations, or colonies, which are in consequence largely inbreeding units. This fact is of primary importance. If the distribution of no species is effectively continuous, there must be some degree of isolation which will interfere with the transference and interchange of germ-plasm. In other words, the free flow of genes will be restricted to a greater or lesser degree. It has been shown by Fisher (1930*a*, p. 76) that the chances against an individual gene which has been introduced into a population becoming established as part of the genotype of that population are considerable, even if that gene is slightly favoured. From this it follows that, if the populations making up the whole species are to be kept as it were "up to date" with respect to the genetic changes that arise in different parts of the distribution, there must be a fairly regular source of introduction. Gametic migration is out of the picture. The evidence suggests that zygotic migration is unlikely to have any extensive effect except possibly through the foundation of new colonies, and this presupposes that there are a number of loci from which the species is now absent but in which it could live if it got there. How far this is true it is impossible to say, though in view of the dynamic nature of many habitats it is perhaps more generally true than is often admitted. The only other source of introduction is by the repetition of the same mutation both in the same and in different parts of the species distribution. The same mutants are known to recur in the standard conditions of culture. How far is this true in the varying conditions of nature?

C. nemoralis introduced into America has apparently produced band forms that have not been reported in the old world (Taylor, 1907–1914); on the other hand, *C. hortensis* which occurs naturally on the north-eastern seaboard is, so far as I can ascertain, less variable there than it is in Southern England.

The band form 00300 is widely distributed through British populations of *nemoralis*, occurring in 86 per cent of the 240 samples I have examined, and in 6 out of 8 French samples. Out of 61 Irish samples it is only present in 31 per cent, but this figure cannot be taken as representative since 48 of these samples came from the Bundoran area (Donegal), where it was apparently absent from the foundation stock of the dune populations. Stelfox (1911), dealing with the Irish distribution, states that this form is seldom seen on the north-west coast of Donegal but is the commonest form on part of the coast of Kerry. A very different distribution of this form is found in *hortensis*. It is established in parts of the Continental distribution, but has apparently only been recorded once from Norway (Økland, 1925). In the British Isles it is in my experience practically confined, as an established genotype, to some populations in Kent and Sussex—out of 66 samples from these counties it was present in 18, or 27 per cent. Out of the remaining 246 samples it was found in only 5, or 2 per cent, and in each of these it was represented by a single rather abnormal shell. In the British Isles with the exception of South-East England, the presence of this variant may almost be considered as diagnostic of *nemoralis*. Are we to suppose that this genotype, which can occur widely in *nemoralis*, is selected against in *hortensis* except in certain circumstances which must be supposed to be present in parts of the Continent and South-East England; or that the mutant has occurred far more rarely in the latter species and that owing to the effective isolation of colonies it has not yet had the opportunity to establish itself in a wider area?

The distribution of the band form 10305 makes an interesting comparison with the last case. On the Continent it is a well-distributed genotype of *hortensis* and is almost diagnostic of this species (it occurs in each of the three French samples I have seen). It is reported from several stations in Norway (Økland, 1925). In the British Isles I have seen no colony in which it is established. Out of 312 samples it is present in only 2, or 0·6 per cent, and each of the three specimens obtained has the appearance of being an aberrant non-heritable form. Out of 310 samples of *nemoralis* five single specimens have been found, and I have no information that it occurs anywhere as an established genotype of this species.

Other Isolating Mechanisms.

If the existing spatial isolation is as effective a restriction upon gene-flow as these facts suggest, there is opportunity in the long course of time for small genetic differences, e.g. chromatin rearrangements, translocations, and inversions, such as are known to distinguish races and closely related species of *Drosophila* (for discussion see Dobzhansky, 1937), to accumulate in different areas of population. Such an accumulation introduces a new type of isolation—genetic isolation—which by the reduction of cross-fertility will limit the amount of gene-flow even if spatial isolation is broken down. There are yet other types of isolation which may be equally effective in that they prevent any genetic barrier that may be building up from being tested too frequently. Small hereditary differences in habit, behaviour, or genital morphology, fostered perhaps by spatial isolation, may lead to selective mating between individuals. Such "psychological" and mechanical barriers undoubtedly operate between closely related species which live in mixed colonies, as they not infrequently do (Diver, 1939).

I have observed an interesting attempt at a cross between two species now placed in different genera, *H. aspersa* and *C. hortensis*. There is no marked spatial isolation between these two species since their geographical distributions overlap widely and they are not uncommonly found together in the same habitat. Nevertheless it may be presumed that they are normally separated by the three other types of barrier which would be tested in the following order—a psychological barrier produced by differences in courtship behaviour, a mechanical barrier raised by differences in the genitalia, and a genetic barrier which might be expected to prevent any fertile union between the gametes. The facts of this observation were that a single *hortensis*, which, owing to shortage of space, had been isolated in a cage containing two *aspersa*, was found to be in courtship with one of them. When this courtship had been in progress for a little time the other *aspersa* became sexually active and attempted to intervene, but much to my surprise without any success. The original pair continued for many hours making innumerable futile attempts to mate, before they finally gave up the struggle. Though in this case the "psychological" barrier failed to hold, the mechanical barrier did, and the genetic barrier was never tested.

The existence within a single species of any one or more of these barriers will, in so far as they are effective isolating agents, restrict gene-flow and thus encourage the formation of genetically differentiated stocks which in the course of time may become recognizably

distinct species. But it must be remembered that even at this late stage of differentiation these barriers may not be entirely unsurmountable, and occasional germinal interchange may still be taking place. Lang (1908) showed that *hortensis* and *nemoralis* could be made to cross, though with a difficulty measured by the fact that only an occasional F_1 hybrid was obtained. Boettger (1921) reported the probable occurrence of such hybrids in a natural population. Stelfox (unpublished) was more successful as he obtained from a single cross several F_1 hybrids which he was able to inbreed and later to back-cross with both parent species. In nature these two species must frequently meet. They were found living together in 16 per cent of the *Cepæa* colonies I have examined. The experimental results show that the mechanical barrier to their mating is not formidable and that the genetic barrier can still be overcome. But observations which have been summarized elsewhere (Diver, 1939) show that a "psychological" barrier exists which should effectively prevent the genetic barrier from being tested to any serious extent. If cross-matings were freely attempted, the individuality of these species would be threatened, and through the production of fully fertile hybrids they might again become swamped in a single large species.

Variation in Behaviour and Habits.

The possible effects of small differences in behaviour and habits as agents in the isolation of species or in the breaking up of a species into potentially differentiating stocks makes the study of the variation or elasticity of these characters of primary importance. In the two species of *Cepæa* the differences in courtship appear to be associated with morphological changes in the shape of the dart and the size of the jaw; but if this behaviour itself is variable or adaptable, it is possible that some individual *nemoralis* may be less objectionable to *hortensis* than others. There may also be many differences of this type which are uncorrelated with changes in form and which can only be detected by close observation of the animals in nature. Such are differences in the normal times of movement and rest, in the degree of atmospheric or soil moisture which will stimulate movement, or in the periods of maximum sexual activity. In some groups, e.g. in insects, in which there is a short well-defined period of sexual activity, closely related species or subspecies may be effectively isolated because their mating periods seldom overlap. Other habits, such as a tendency to climb, may result in distributing sexually active individuals through

different layers of the same plant community. Any variation in the exact ecological niche which an individual or group of individuals may choose can increase or decrease the likelihood of cross-mating.

From the ecological aspect, the adaptable or widely tolerant species has a great advantage over those that are closely adapted or can only live within a very narrow range of conditions. This adaptability may be comparable to the morphological plasticity considered earlier. On the other hand, it may be due to hereditary variation which determines that some individuals prefer one set of conditions to live in while others do better in a different set. Such variation may result in the course of time in the production of a definable ecological race or subspecies. These and similar considerations illustrate the need for the preliminary measurement of tolerance ranges and for careful studies in ecological variation.

Comparatively recently *Hydrobia jenkinsi* apparently underwent some sudden change which enabled the species, or perhaps only some individuals, to spread rapidly into a new habitat (for a summary of the facts see Robson, 1923). The species reproduces parthenogenetically so that gametic transference of new mutations is impossible, and gene-flow is limited to zygotic migration. Whether in the course of time these circumstances will result in the splitting of this species into two recognizably distinct races inhabiting fresh water and brackish water habitats respectively, or whether the parthenogenetic habit will give rise to a swarm of micro-species such as those found in apomictic plant genera (e.g. *Hieracium*, *Taraxacum*), is a problem for the future. But what we already know of this species makes it imperative that the closest watch should be kept on all aspects of its ecological and morphological behaviour.

The Categories of Variation.

Direct studies of the distribution of variants in the natural units of population provide clues that are of value in determining to which of our three categories different variants may belong. A variant which is always rare and is scattered sporadically through colonies without any apparent relation to particular ecological conditions or geographic districts is very probably referable to the third category. On the other hand, equally rare variants which appear on plotting to be associated more regularly with certain districts than others or are known to have cropped up in certain colonies through a series of years, or generations, must be regarded as suspect. It is sometimes possible to separate a third category

phenocopy from a first category mutant of the same variant, as in the case of sinistrality cited above. Phenocopies of genetic band-types in *Cepæa* are more distinguishable, as the established genotypes show a clear-cut pattern which is usually absent in the phenocopies. The five sporadic occurrences of the band type 00300 in British *hortensis* are not in the least like the Kentish and Continental genotype. One was a shell markedly aberrant in other respects ; the other four, which were collected in Somerset and Dorset, are all of the same type, that is the single band is half-hyaline, and the shells give the impression of being an unusually marked expression of the "ghost-banding" that is often seen on genetically unbanded shells. In both the *hortensis* colonies containing 10305 the interesting feature is not the occurrence of this banding, but that the colonies are quite unusual in containing a great number of different band-types represented by one or two specimens. The simpler of them will serve as an instance. The following forms were represented by single shells : 00305, 10305, 10045, 10345, 1.345 ; and by two shells : 12045, 1.3.5 ; there were also 146 typical five-banded shells and 37 unbanded. In the other colony no fewer than twenty types in which one or more bands were missing, faint, or remarkably thin were recorded. It is not improbable that a general disturbance of this nature, which is more common in *nemoralis* than *hortensis*, has a genetic basis, but one which is not the same as the 10305 genotype. These figures may be compared with a Kentish colony containing : eighty-four 00000 ; eight 00300 ; seventy five-banded.

Second category variants, whether phenocopies or not, are more readily recognizable. In most cases the variation is not of a sharply discontinuous type and the frequencies of the variants are somewhat differently distributed, even when they are not obviously associated with some particular ecological condition. Such variants are not normally distributed as sporadics or with irregular low frequencies in colonies from different habitats. They are more likely to form all or a large proportion of a colony or to be altogether absent, as in the instances of *L. peregra* and *H. jenkinsi* given above ; and they are certainly liable to persist so long as the habitat remains unchanged. In more obscure cases the comparative behaviour of two species may provide a valuable test (Boycott, 1920). The persistence of particular frequencies through a number of generations is a criterion which cannot be neglected, and therefore whenever possible colonies should be re-examined after intervals of time which bear some relation to the normal rate of replacement by new generations. The frequency and distribution of first category variants may change over a period

of years without relation to stability or similarity of conditions; but this is not true for second category variants, and third category forms should not persist at all.

Summary of Some of the Questions which Require an Answer.

The instances quoted in the preceding sections give some picture of the wide field in which our knowledge may be advanced by detailed observational studies of natural populations; but it may be convenient to summarize the different kinds of fact that such data can be expected to reveal. These may broadly be grouped under three headings: the behaviour of individual variants; the total expressed variability of a species; and comparative variation as between related species or within the races of a single species.

The following questions may be asked in relation to any particular variant: whether it is sharply discontinuous and to what extent it fluctuates, or whether it overlaps other variants and, if so, how much; what is its frequency in a series of colonies; whether these frequencies change over a period of time; whether different frequencies are related to different geographical areas and, if so, whether they are arranged in clines; whether they tend to be associated with different ecological conditions; whether the total distribution of the variant has a geographical or ecological significance; whether and, if so, how its distribution is spreading or contracting; how is it distributed within single colonies and whether this distribution is changing; if hereditary, what indications are there of the mutation rate; in what circumstances may the variant be produced, i.e. is it restricted to one category, or can the same result be produced by genetic mutation as well as by second or third category phenocopies, and, if so, how are the distributions of these forms related to each other; what is the nature of the variant, i.e. is it the product of differences in rates of development, or in any way subject to the laws of heterogonic growth; and whether there is any evidence, e.g. by direct attack, of selective control.

Examination of the total expressed variability of a species is largely but not entirely the summation of the facts collected for individual variants: what is the total range of variation; how many attributes (or spherules) are variable or constant; what types of character are most or least variable; whether there is any indication of geographical or ecological races and, if so, what happens in the zones where the races meet, are they sharply divided or do they overlap; whether the amount of variation changes from the centre to the periphery of the species distribution, or in any

other regular manner; what differences are there between recent and fossil populations; how is the total variation divided between the three categories, i.e. is it mainly hereditary or is there pronounced ecological plasticity; whether the species can be said to be polymorphic in the restricted sense of Fisher and Ford; what is the distributional and breeding structure of its populations; what is the amount of individual movement within colonies or between adjacent colonies; what differences are there in the habits of the parents and the young; whether the general variability of the young is greater than that of the adults; what evidence is there of correlation between different variants; and what can be determined by inspection in regard to the genetic relations of variants, e.g. dominance and linkage.

The third group of questions arises when answers have been obtained to some of the questions in the two preceding groups in respect of two or more species or races: how do species or races differ in the amount and range of their total variation; what is the nature of this difference; does the variability of comparable characters differ, i.e. is one species most variable in colour and another in pattern; to what degree, and in which characters, is variation parallel; how widely does this parallelism spread through a group of species (genus, family); how do they differ in the amount of variation in each category, i.e. are there differences in the frequency of fluctuations and abnormalities (e.g. the frequency with which reversed examples occur), or in the degree of ecological plasticity; how do the total geographical distributions and ecological ranges of tolerance differ; what differences are there in the geographical or ecological distribution of comparable individual variants; do there appear to be any differences in the genetic relations of comparable variants; do the species live together in mixed colonies; what evidence is there of mechanical, "psychological," or other barriers to cross-mating; and is there any indication of hybridization.

These and many similar problems are largely a matter of fact finding by the simple process of careful observation and collection which is the stock in trade of every field naturalist. Any one of these questions is worth the answering, few require the possession of any recondite knowledge, and much information can be obtained by the detailed study of even a small neighbourhood. Some of the wider problems are hardly within the scope of individual workers whose time and chances of travel are closely limited, but they can well be attacked by a group of investigators living in different areas who are prepared to work in collaboration on a general scheme. As Bateson pointed out in 1894 (p. 574), many of the problems of

variation are pre-eminently suited for investigation by simple means and can be attacked by those who have none of the paraphernalia of modern science at their command. Conchologists have already proved the truth of his words; but as we climb the view over the unexplored territory becomes wider and wider. Many of the questions that can be asked to-day spring from the new field of vision which Bateson's own work was so largely responsible for revealing.

In conclusion, I would express the hope that through the further study of variation we may ultimately be able to give, at least for the common British species, a full biological description. Such a description must embrace not only the morphology and spatial distribution of the species, but its ecology and bionomics in the widest sense, for these are equally the practical expression of its biochemical and physiological constitution; and the description is not completed until the whole sphere of variation in all these aspects has been delimited, analysed, and measured.

It is a startling fact that we cannot even yet give such a description of any single species.

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ABNORMAL *ACANTHOCHITONA CRINITA* PENNANT.

At the end of August last, at Portscatho, during an ordinary spring-tide we discovered a specimen of *A. crinita*, with only seven valves, the first abnormal Chiton I have ever taken.

It was on a rock under coarse weed, and we took two normal *crinita* in the same vicinity. In the same locality very large *Patella vulgata* occurred, two measuring $2\frac{7}{8}$ in. in altitude and two others $2\frac{3}{4}$ in.

Musculus costulatus and large *Littorina littoralis* var. *ornata* also occurred. The following species were also found living at Falmouth :—*Alvania punctura* Mont., *Lepidopleurus scabridus* Jeff., *Callochiton achatinus* Brown, *Triphora perversa* L., *Philbertia purpurea* Mont. with twisted spires, *Arca lactea* L., *Modiolus barbatus* L., and *Chlamys distorta* da Costa.

W. FOWLER.

ZOOGENETES HARPA (SAY) IN SWITZERLAND.

By Chas. Oldham.

(*Read before the Society, 12th November*, 1938.)

In 1887 A. E. Craven found this snail under dead wood, especially fallen fragments of bark of the Arolla pine, at approximately 7,000 feet, on the Riffelalp, near Zermatt in Valais. Nine of his specimens are now preserved in the British Museum (Nat. Hist.) at South Kensington. In a short note announcing his find,[1] Craven, very properly, emphasized the interest of the occurrence in the Alps of a snail which, until then, had been found only in very high latitudes. Some thirty years later E. Paravicini announced its occurrence, in 1916,[2] among the ruins of the castle at Tourbillon, near Sion, in the valley of the Rhone ; apparently a very unsuitable habitat for it, for as G. Mermod pointed out in 1930 [3] the snail fauna at Tourbillon is mainly composed of characteristic southern xerophiles. He was then evidently sceptical about the occurrence of *harpa* there, but in a recent letter he tells me that he has now seen Dr. Paravicini's three specimens, which are fine characteristic examples of this species. Dr. Mermod suggests that in view of its presence at Tourbillon and of the occurrence of a characteristic xerophile, *Chondrula quadridens* with it in our locus on the Riffelalp, the idea that *harpa* is an essentially hygrophilous species can be held no longer.

Since 1887 the known distribution of *harpa* has been extended considerably ; it has been shown that not only is it circumpolar in its range, but that it lives in places at lower latitudes than Zermatt (46° N.), then believed to be its southern limit, e.g. at Estes Park, Colorado, U.S.A. (*circa* 40° 40′) ; a locality south-east of the Caspian (*circa* 37°) ; and Teberda in North Caucasia, which too is south of the parallel of Zermatt ; but these discoveries and the presence of *harpa* in other isolated and outlying parts of its range only confirm the idea, long held, that it is a glacial relic.

Craven collected his specimens somewhere about the 7,000 ft. contour line, but just whereabouts on the Riffelalp is not known. It certainly is not in all the places on the mountain where the Arolla pine grows, for it has been sought again and again without success ; and, despite Craven's circumstantial story and the evidence of his specimens in the British Museum, it has been

[1] Journal de Conchyliologie. xxxvi, p. 101, Jan. 1888.
[2] *Die Mollusken der Walliser Talsohle von Brig bis zum Genfersee.* Nachrichtsbl. d. deut. Mal. Ges., Bd. 50, p. 153.
[3] Cat. des Invertébrés de la Suisse (Fascicule 18, Gastéropodes), 1930.

suggested that, inadvertently, specimens from some other locality —perhaps from some other continent—had got mixed with mollusca from the Riffelalp and that *harpa* never existed there at all.

Hearing that my wife, my sister, and I had searched without success on the Riffelalp in June, 1931, the late Dr. R. F. Scharff, whose interest in the distribution of animals is well known, wrote :—

"I was greatly interested when, in 1888, Taylor announced the discovery of this arctic species on the Riffelalp, and I hoped some day to hunt for this most interesting species myself. However, it was many years afterwards that I got the chance to reach the Riffelalp which is surrounded by the woods of the Arolla pine, under the fallen bark of which Craven met with the snail. It was in June I went, but, although I searched every bit of bark carefully, the only snail I discovered that bore the least resemblance to *A. harpa* was *Euconulus fulvus*. A second visit was equally unsuccessful, and a couple of years ago I paid a third visit to the place. I then brought away a large sackful of material for sifting, but found nothing. You are my last hope, as great heights don't suit me any more."

We hunted again on the Riffelalp in the spring of 1934, and again we failed ; our fortune was no better than that of others before us, and *harpa* still evaded detection. In September, 1937, we tried again, and late in the afternoon of the 15th, the last day of our holiday, my wife found a dead—but only recently dead—full-grown shell under a stone. We could do nothing more in 1937, but in September, 1938, we were again at Zermatt, and on this visit we had the help of two sharp-eyed and enthusiastic nieces. We made for the place where we had found the dead shell in 1937, and within a few minutes found a living *harpa* on a piece of stick and many more in a short time.

Our hunting-ground was a rocky hillside at 7,000 to 7,300 feet that rose steeply above the mule-track from the Riffelalp Hotel and railway station to the Grünsee. It is covered by bilberry, bearberry, juniper, crowberry, alpenrose, and similar shrubby plants, with here and there an Arolla pine or larch—we were nearly at the tree limit—and beneath the shrubs a thick growth of mosses and liverworts. The place has a north aspect and over-looks the Findelen Gorge and the thickly wooded slopes of the Vordere Wald. Most of our *harpa*—some sixty in all, apart from dead shells—were collected here, but we got a few at a lower elevation, about the mule-track through the larch-woods between the Grünsee and Findelen Bridge. There had been heavy rain two days before our first visit ; the ground and vegetation were still

damp and the snails adhering to the underside of fragments of bark, sticks, stones and patches of dry cow-dung. Our second visit was after four days of dry, warm weather, and we found virtually none in such places, but many in the mosses and liverworts beneath the shrubby plants. On the ground where we collected most of our specimens, between 7,000 and 7,300 feet, we found other fourteen species—for identifying some of them I have to thank Dr. Mermod—*Limax cinereo-niger* Wolf, *L. tenellus* Müll., *L. arborum* Bouch.-Chant., *Agriolimax agrestis* (L.), *Vitrina annularis* Venetz, *V. nivalis* Charp., *Arion subfuscus* (Drap.), *Euconulus fulvus* (Müll.), *Punctum pygmaeum* (Drap.), *Goniodiscus ruderatus* (Studer), *Helicigona cingulata* (Studer), *Chondrula quadridens* (Müll.), *Pupilla muscorum* var. *alpicola* (Charp.) and *Cochlicopa lubrica* (Müll.). At about 5,500 feet, on the lower slopes of the Riffelalp, we found *Agriolimax laevis* (Müll.), *Arion circumscriptus* Johnst., and *A. hortensis* Fér., but not on the higher ground.

The majority of the living *harpa* were immature, from a quarter to three-quarters grown, and, no doubt, many still smaller escaped our notice. Most of the mature shells were dead, but many of them could only have been dead for a few days, and some of the living ones that I sent to Colonel A. J. Peile contained embryos. Whether the snails are torpid, or to some extent active, in the winter I do not know—they would be warm enough under the deep snow and able to move about, and to feed among the dead leaves—but the inference is that *harpa* has a life cycle of a year or thereabouts, is born in the summer or early autumn, matures in the summer of the following year, then produces young and dies.

How *harpa* has escaped the notice of naturalists on the Riffelalp for so long is not clear—it has been looked for often enough—but it may be that it is really very local and that it is absent from the neighbourhood of the mule-track through the woods between Winkelmatten and the Riffelalp Hotel, and the slopes just below the hotel itself where there are many Arolla pines. To this area our search, prior to 1938, was virtually restricted—as I incline to think was that of others as well—but it is incredible that it does not occur in other parts of the mountain where the conditions are similar to those of our rocky hillside, and indeed in other parts of Valais. Our experience in 1938 contributed nothing to the solution of the riddle of the discontinuous distribution of *Zoogenetes harpa*, but it throws some light on its habits and habitats in the Swiss Alps, and confirms the validity of Craven's record for the Riffelalp of more than fifty years ago.

A NEW SOUTH AFRICAN VERMETID.

By J. R. le B. Tomlin

(*Read before the Society 11th February, 1939.*)

Vermetus (*Stoa*) *corallinaceus* n. sp., Pl. xii, fig. 4.

Shell whitish, entirely adherent, in a closely conglomerate mass of irregular coils; fairly solid, obtusely and often very obscurely carinate; sculpture consisting of closely packed, raised, annular ribs which vary considerably in character, being sometimes lamelliform and sometimes filiform, the two forms occurring quite irregularly together; the diameter of the tube does not vary much and is on the whole about 2 mm.; operculum circular, centrally concave outside with a raised ring round the concavity, convex on the inside.

Protoconch apparently consisting of about a whorl and a half, smooth, thin, and blackish brown in colour.

With rare exceptions the tubes of this species are covered by, or embedded in, one or more species of corallinaceous algæ belonging to *Lithothamnion* or some allied genus.

Hab. Oudekraal, where it occurs in amazing abundance.

I am greatly indebted to Professor T. A. Stephenson for a plentiful supply of material and for details of habitat.

Lt.-Col. Peile has mounted numerous specimens of the radula and with his usual courtesy furnished the following figure and report thereon.

There is a well developed pair of arcuate jaws the structure of which appears to be prismatic. The elements forming the opposed edges are elongated so as to form a fringe of short rods.

The radula figured has twenty-three rows of fully developed teeth. It is the only one of eleven examined that shows any sort of abnormality, which in this case is a split mesocone on all the teeth in one line of laterals.

The lateral and marginal teeth in the front four or five rows are somewhat blunted indicating contact with gritty food.

The figure shows one row of teeth from the centre of the radula with the inner marginals turned inwards on one side and outwards on the other (Fig. 1).

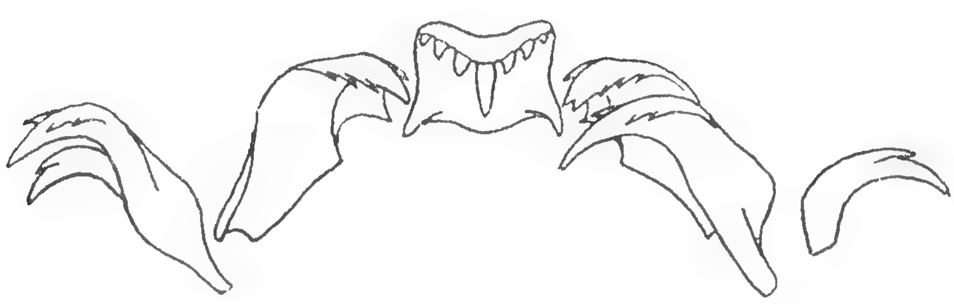


Fig. 1.—One Row of Teeth (magn. × 300).

NEW LAND SHELLS FROM THE MALAY PENINSULA.

By J. R. le B. Tomlin

(*Read before the Society 11th February, 1939.*)

For the three new species here described I am indebted to the Raffles Museum. The holotypes will be deposited in the British Museum, as were those described in this Journal, vol. 21, pp. 73–5.

Sinoennea lenggongensis n.sp., Pl. 12, fig. 1.

This new species bears considerable relationship to *S. siputana* [1] and comes from Lenggong which is only about 20 miles from Sungei Siput.

The two differ, however, in several important particulars: the new species is distinctly longer and has a whorl more than *siputana*; it has a fairly large, open umbilicus, an aperture rather less oblique and broader in proportion to length; the sutures are deeper, and the axial costulations are finer and packed much more closely together, there being about forty-five of them on the penultimate whorl; the columellar lamina is in spiral form and not a vertical thickening as it is in *siputana*; the palatal plica also is of different form and the lower part of it more deeply immersed.

Long. 3·5 mm., diam. max. 1·75 mm.

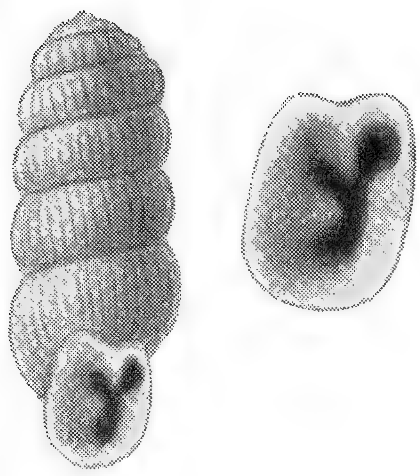
Hab. Lenggong, Perak.

Hypselostoma terae n.sp., Pl. xii, fig. 2.

Very similar in most ways to *Boysidia kelantanensis* Sykes, but according to Pilsbry's generic table in *Man. Conch.* (2) vol. 24, p. 174 it must be placed in *Hypselostoma* on account of the last whorl which becomes free and projecting for part of its extent.

Shell chestnut-brown with about five convex whorls and having widely-spaced lines of growth which are more distinct and regular than in *B. kelantanensis* especially on the last whorl: it is deeply rimate rather than perforate and may at once be known by the fact that the dorsal part of the last whorl has a strongly raised peripheral keel; the teeth are fewer than in *B. kelantanensis*, viz. one short and rather strong parietal lamella, one short, deep-seated, horizontal, columellar lamella, one basal plica and one inconspicuous little plica within the outer lip; this is sometimes absent owing no doubt to immaturity.

[1] See this Journal, vol. 21, p. 75, Pl. 11, fig. 6.



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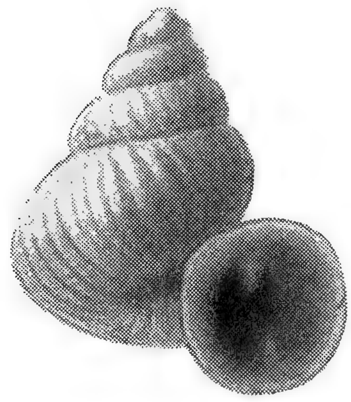

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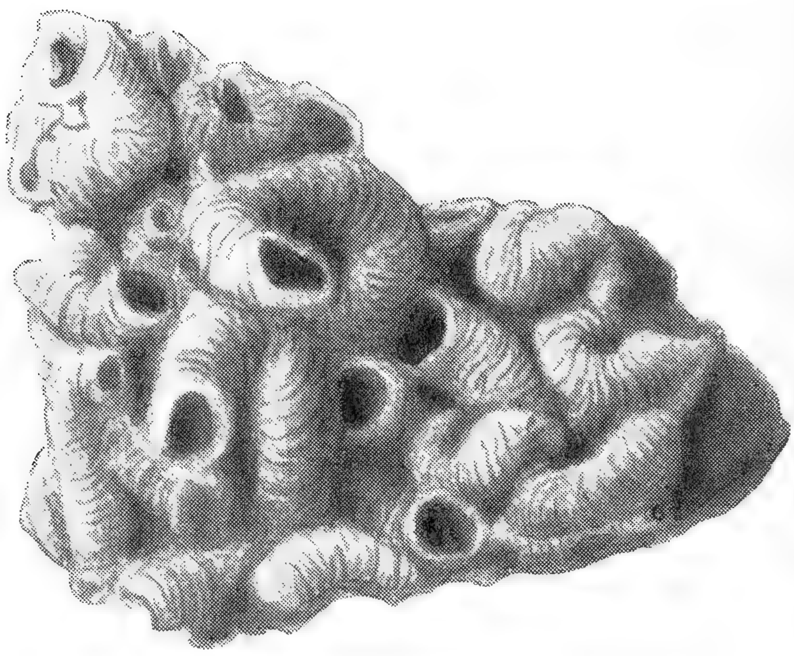

4

[*See pp* 145–7.

Long. 2·5 mm., diam. max. 2·5 mm.

Hab. Bukit Chintamani, Pahang.

Named after Miss Tera van Benthem Jutting of the Amsterdam Zoological Museum, who is always so ready and anxious to help enquirers along.

Oospira johorensis n.sp., Pl. xii, fig. 3.

Shell dark chestnut-brown, dull, fusiformly tumid, whorls nine, increasing rapidly, the last two being narrower than the two which precede them; apex broad and blunt; protoconch shining, light brown, consisting of three whorls, finely and closely striate; the subsequent whorls are smooth until the last two—on these the growth-lines tend to assume the form of fairly close striæ especially at the base of either whorl; sutures deeply impressed; mouth very nearly circular, reddish brown within; peristome solute, thickened and reflexed, the outer margin reddish, the inner dark brown; parietal lamella pinkish (in the fresh shell), slightly sloping towards the outer margin; subcolumellar lamella plainly visible, and reaching the inner margin of the peristome; parietal plicæ five in number, parallel to the sutures, the uppermost one very long, the next about one-quarter of the length of the first, the third and fourth about half the second, the fifth half as long again as the third and fourth.

Long. 29 mm., diam. max. 6·5 mm.

Hab. Gunong Panti, Johore, in lowland jungle, March, 1938.

Shells of this species vary individually, especially in length and in shape of aperture. It may be known at once from *penangensis* Stol. by the broad, blunt apex.

The genotype of *Oospira* Blanford is the well-known *philippiana* Pfr. from Moulmein. The build of the few species assignable to *Oospira* is so distinct, especially in the matter of the broad, blunt apex, that it seems convenient to treat it as a genus.

PLATE 12.

FIG. 1.—*Sinoennex lenggongensis*, n. sp.
,, 2.—*Hypselostoma terae*, n. sp.
,, 3.—*Oospira johorensis*, n. sp.
,, 4.—*Vermetus* (*Ston*) *corallinaceus*, n. sp.

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN & IRELAND.

653rd Meeting, held at the Manchester Museum, 3rd September, 1938.

Mr. G. C. Spence in the chair.

Election of New Members.

Tom Burch. Joseph M. Grech.

Members Deceased.

Professor A. E. Boycott. Lt.-Col. W. H. Turton. Dr. F. Baker.

Papers Read.

" *Thracia antarctica* M. & S. and *Mya antarctica* M. & S.," by J. R. le B. Tomlin.

" A New Subgenus and Genus of Tertiary Pectinids," by Mrs. H. I. Tucker Rowland.

" Recent Changes in the Molluscan Fauna of Burton Marsh, Cheshire," by Mrs. McMillan.

Exhibits.

By Mr. F. Taylor : *Helix hortensis* and vars. *lutea, arenicola* and *olivacea,* from Finglas Bridge, Dublin ; also *H. itala* var. *leucozona* from the same place ; *Cecilioides acicula,* dead specimens, also 50 living examples, one adult with enclosed calcareous egg ; also newly-hatched young of same species and calcareous egg extracted from living adult, from Miller's Dale, Derbyshire, 11–6–38 ; *Zonitoides excavatus* and eggs, *Vitrea alliaria, V. radiatula* and var. *viridescenti-alba, V. crystallina, Euconulus fulvus, Carychium minimum,* and *Arion minimus,* from Trows, Castleton, near Rochdale.

By Mr. C. H. Moore : *Lymnaea glabra,* from Bardsley ; *Zonitoides excavatus,* from Stalybridge ; and large shell of *Limax maximus.*

By Mr. G. C. Spence : African *Cerastus.*

By Dr. J. W. Jackson : *Pomatias elegans,* from Ventian end of sand-hills, Woolacombe, May, 1938 ; and 41 species of marine shells from Barricane shell-beach, Woolacombe.

654th Meeting (Annual Meeting), held in the rooms of the Royal Society, London, 15th October, 1938.

The President, Captain C. Diver, in the chair.

Present : Messrs. J. G. Dalgliesh, G. Shrubsole, A. P. Gardiner, A. E. Salisbury, G. C. Spence, A. Wrigley, A. Blok, C. Oldham, J. E. Cooper, G. L. Wilkins, H. C. Fulton, A. S. Kennard, R. Winckworth, J. R. le B. Tomlin, Lt.-Col. A. J. Peile, Drs. H. E. Quick and J. W. Jackson, Mrs. E. M. Morehouse, Mrs. A. I. Anderson, Miss J. D. Robertson, and Miss K. M. White, also several visitors.

Apologies for absence were received from Mrs. N. F. McMillan, Messrs. A. K. Lawson, W. J. Davey, and B. Bryan.

Election of Scrutineers.

Messrs. A. Blok and G. Shrubsole were elected scrutineers.

Election of Auditors.

Messrs. C. H. Moore and A. K. Lawson were elected auditors.

Candidates Proposed for Membership.

Alexander Comfort, Havengore, Tudor Road, New Barnet, Herts (introduced by G. L. Wilkins and A. P. Gardiner).

Mrs. Gladys I. Fowler, c/o Messrs. Lithgow & Pepper, 41 Wimpole Street, London, W. 1 (introduced by A. P. Gardiner and J. W. Jackson).

F. H. Ludham, Kopaci, Mayfield Road, Falmouth (introduced by W. Fowler and A. P. Gardiner).

Dr. Henry van der Schalie, Museum of Zoology, University of Michigan, Ann Arbor, Michigan, U.S.A. (introduced by H. H. Bloomer and J. W. Jackson).

Annual Reports.

The Annual Report of the Council ; the Reports of the London, Leeds, and North Staffs Branches ; the Reports of the Curator and of the Recorder for Marine Mollusca were presented and adopted.

President's Address.

Captain C. Diver gave his Presidential Address on " Variation ".

On the motion of Mr. R. Winckworth a cordial vote of thanks was passed to the President.

A vote of thanks was also passed to the authorities of the Manchester Museum for the use of rooms for the meetings of the Society.

Election of Officers and Council for 1938–9.

The Scrutineers reported that the Officers and Council for the ensuing year as nominated had been duly elected (see p. 89).

Exhibits.

By Mr. G. L. Wilkins : Models of British Nudibranchs.

By Mr. J. G. Dalgliesh : British Marine Mollusca.

By Mr. J. E. Cooper : *Turbinella pyrum* L., egg-capsule, embryos, young shells and mature shell ; also *Zaplagius* (3 species), *Odontostomus* (12 species), *Anostoma* (2 species) and *Tomigerus clausus* Spix.

By Dr. H. E. Quick : *Helix aspersa*, from Penzance, showing the " Nevin " disease.

By Lt.-Col. A. J. Peile : Shells of Streptaxidæ, 6 species, including new forms and varieties, lately received from the Gold Coast ; radulæ and shells of *Hyalimax perlucidus*, from Mauritius ; *Latirus polygonus* Gmelin, from South India ; *Nassarius gruneri* Reeve, from Mauritius.

By Dr. S. T. and Mrs. B. W. Brooks : Three notebooks and maps showing circumpolar species which occur in Newfoundland.

By Mr. J. R. le B. Tomlin : Examples of *Ryssota quadrasi* Hidalgo just received from the Philippines ; *Cypraea hirasei* Roberts, *C. hesitata* Iredale white var., *Halia priamus* Risso, and the following species of *Aporrhais* : *serresianus* Mich., *senegalensis* Gray, *macandreae* Jeffreys, *conemenosi* Monts., and *occidentalis* Beck with its recently described varieties, *mainensis* Johnson and *labradorensis* Johnson.

By Mr. R. Winckworth : Nudibranchs from the Seychelles, including specimens, photographs, and coloured films taken by Colonel H. C. Winckworth, and paintings from life by Miss Bailey. Also, examples of *Mauritia arabica* (L.) *sensu lato*, a " rassenkreis " which seems sufficiently differentiated to be regarded systematically as seven species : *grayana, arabica, histrio, depressa, maculifera, scurra, and eglantina*.

By Mr. A. P. Gardiner : A few of the 600 census maps, showing points of interest in the distribution of our marine mollusca ; specimens of the shells were also exhibited : *Spirula peronii* Lam. from Croyde, North Devon ; the heavy form of *Mactra glauca* Born, that used to be cast up between Lelant and St. Ives, and Channel Islands specimens for comparison : a valve of *Divaricella divaricata* L. from the same locality ; a fresh but dead *Cardium papillosum* Poli, dredged in 1937 at St. Mary's, Scilly, by W. Fowler ; views of the habitat of *Onchidella celtica* in Cornwall ; *Vitrina pellucida* Drap., from a salt-marsh at Burnham-on-Sea, taken on salt-water algæ during a hard frost in January ; a letter of J. Gwyn Jeffreys, found in a copy of *British Conchology*, bought at Reading : the letter was addressed to a well-known conchologist named Wiltshire.

ANNUAL REPORT, 1937–8.

This is the Sixty-Second Annual Report. Since the last Annual Meeting there have been the following losses in membership: deaths, eight; resignations, three; struck-off, three; a total of fourteen. The elections of new members have been four only. The membership now stands at 207.

The deaths include Henry Crowther, the last of the four Founders of the Society (see this Journal, p. 69), R. A. Adkin, A. Hartley, Rev. T. P. Levett, J. H. Goodson, Rev. G. A. Frank Knight, Professor A. E. Boycott, an ex-President and Recorder for Non-Marine Mollusca (see p. 58), and Lt.-Col. W. H. Turton (see p. 66).

Six ordinary meetings have been held at the Manchester Museum by the kind permission of the authorities. In addition there was a most successful joint meeting at Leeds in November (see this Journal, p. 54) and a similar one at Manchester in April (see p. 87).

During the past year twelve papers and notes were read, and there were three Special Exhibits.

On 24th May an Address, signed by the President and Hon. Secretary, was presented to the Linnean Society, on the occasion of its 150th anniversary by our Delegate and Editor, Mr. J. R. le B. Tomlin. The text of the letter is given on page 86 of this Journal.

On 15th April the Hon. Treasurer, Mr. Charles Oldham, attained his 70th birthday and a letter of congratulation was sent to him by the Hon. Secretary on behalf of the Society.

Since the last Annual Meeting three numbers of the *Journal of Conchology* have appeared, viz. vol. 21, no. 1, 10th February, 1938, with 32 pages of text, and 1 plate; no. 2, 16th June, 1938, with 24 pages of text, and 8 plates; and no. 3, 22nd September, 1938, with 32 pages of text, and 2 plates. The Society is again indebted to Mr. H. H. Bloomer for generously defraying the cost of the plates and of the greater part of the printing of the text of vol. 21, no. 2.

Additions to the Library have been received from Dr. J. W. Jackson, Dr. Hans Schlesch, Messrs. S. V. Wild, A. K. Lawson, G. C. Spence, C. Oldham, H. H. Bloomer, C. de La Torre, P. Bartsch, B. C. Cotton, F. K. Godfrey, C. J. Gabriel, M. Doello-Jurado, A. Schellenberg, A. Carcelles, J. J. Parodiz, Miss T. van Benthem Jutting, and Mrs. Boycott (a selection from the library of the late Professor A. E. Boycott).

Additions to the Society's Collections have been received from Dr. Hans Schlesch (portrait of a group of four conchologists) and from Mr. J. E. Cooper, who has generously presented his British collections, one cabinet of Non-Marine Mollusca, and one of Marine Mollusca. These are very welcome additions and supplement very considerably the locality series in possession of the Society.

RECORDER'S REPORT (Non-Marine Mollusca).

At the Annual General Meeting held in London, the Council decided to proceed with the revision of the Roebuck Census. The numerous additions since 1921 are at present being checked and new distribution maps are being prepared with the view to publication in the near future. Since the last census considerable attention has been paid to certain critical species of the genera *Milax*, *Helicella* (*caperata* and *heripensis*), *Vallonia* (*excentrica* and *pulchella*), and *Truncatellina*; further material is required to extend the authenticated range of these. As a consequence of the recent revision of the genus *Succinea* by H. E. Quick (*Proc. Malac. Soc.*, vol. xx, 1933, pp. 295–318), all records prior to 1934 have been discarded.

Members who are willing to assist in the revision should send specimens for authentication to A. R. Waterston, B.Sc., Royal Scottish Museum, Edinburgh, 1.

ACCOUNTS FOR THE YEAR ENDED 31st DECEMBER, 1938.

Income and Expenditure Account.

Dr.

	£	s.	d.	£	s.	d.	£	s.	d.
To Annual Subscriptions—									
For 1938—									
13 at 5*s*.	3	5	0						
128 at 10*s*.	64	0	0						
				67	5	0			
Arrears				8	5	0			
							75	10	0
,, Sale of Publications							27	10	7
,, Advertisements								18	6
,, Donation to Publication Costs							29	14	3
,, Transfer from Life Membership Fund							16	16	0
							£150	9	4

Cr.

	£	s.	d.	£	s.	d.	£	s.	d.
By publishing and distributing *Journal of Conchology*, Vol. XXI.									
Pt. 1	24	9	2						
Pt. 2	34	14	4						
Pt. 3	27	8	8						
				86	12	2			
Authors' Reprints				11	15	8			
							98	7	10
,, Glass-topped boxes								2	9
,, Printing and Stationery							4	9	6
,, Fire Insurance								10	0
,, Warehousing Stock							1	10	0
,, Expenses of Annual Meeting							7	7	0
,, Subscriptions—									
Malacological Society				1	1	0			
Lancs. and Chesh. Fauna Com.					5	0			
Zoological Record					5	0			
							1	11	0
,, Officers' Expenses							5	5	1
,, Balance, being excess of Income over Expenditure							31	6	2
							£150	9	4

Life Membership Fund.

	£	s.	d.
To Amount of Fund, 1st January, 1938	355	4	0
,, Dividends and Interest	16	16	0
	£372	0	0

	£	s.	d.
By Transfer to Income and Expenditure Account	16	16	0
,, Amount of Fund, 31st December, 1938	355	4	0
	£372	0	0

Research Fund.

	£	s.	d.		£	s.	d.
To Amount of Fund, 1st January, 1938	256	18	3	By Amount of Fund, 31st December, 1938	269	0	5
,, Dividends and Interest	12	2	2				
	£269	0	5		269	0	5

BALANCE SHEET.

Liabilities.	£	s.	d.	£	s.	d.
Annual Subscriptions paid in advance				4	5	0
Life Membership Fund				355	4	0
Research Fund				269	0	5
Balance of Income and Expenditure Account—						
As on 1st January, 1938	74	1	9			
For 1938	31	6	2			
				105	7	11
				£733	17	4

Assets.	£	s.	d.	£	s.	d.
Investments.						
4% Funding Loan, £408 4*s.* 11*d.*, cost	350	0	0			
4½% Conversion Loan, £202 13*s.* 3*d.*, cost	200	0	0			
3½% Conversion Loan, £40 11*s.* 8*d.*, cost	40	0	0			
				590	0	0
Cash at Bankers				143	17	4
				£733	17	4

NOTE.—Assets in addition to those set out in the Balance Sheet are (*a*) Library, (*b*) Cabinets and Collections, (*c*) Stock of unsold publications, (*d*) Annual Subscriptions in arrear.

Audited and found correct.
C. H. MOORE.
A. K. LAWSON.
6th January, 1939.

CHAS. OLDHAM,
Hon. Treasurer,
31st December, 1938.

Malacological Society of London.

Hon. Sec.: G. I. CRAWFORD, M.A., Brit. Mus. Nat. Hist., Cromwell Road, S.W.7.

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To be had from MR. D. NUTT (A. G. BERRY), 212 SHAFTESBURY AVENUE, W.C. 2, and at the Headquarters of the Society.

For the present all meetings, including the annual one, are in abeyance.

VOL. 21] 21ST SEPTEMBER, 1939. [No. 6

. . THE . . JOURNAL — OF — CONCHOLOGY

FOUNDED 1874.

BEING THE ORGAN OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND.

Hon. Editor:	*Hon. Secretary:*	*Hon. Treasurer:*
J. R. le B. TOMLIN, M.A., 23 Boscobel Road, St. Leonards-on-Sea.	J. W. JACKSON, D.Sc., The Museum, The University, Manchester, 13.	C. OLDHAM, Oxfield, Berkhamsted.

CONTENTS.

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JOURNAL OF CONCHOLOGY.

VOL. 21. 21st SEPTEMBER, 1939. No. 6

DISTRIBUTION AND HABITATS OF ENA MONTANA IN ENGLAND.

By A. E. BOYCOTT.

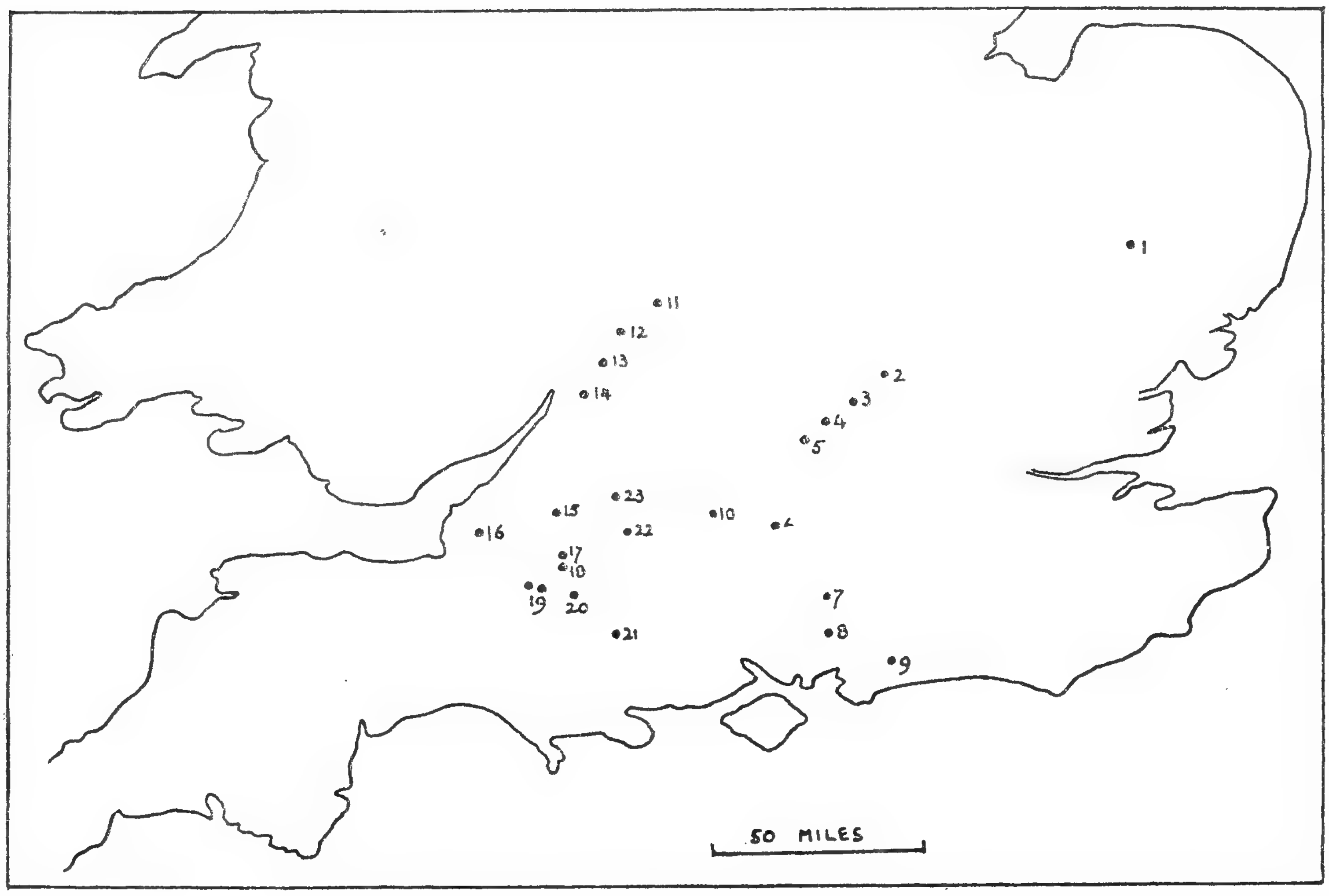
Ena montana is a species which any collector is glad to catch, and as it reaches in England the north-western limit of its European distribution it is of some interest to consider where and in what kinds of places it occurs in this country. The following account is based on (1) the data accumulated by W. D. Roebuck for his *Census of Distribution* and for use in J. W. Taylor's *Monograph* and unless the contrary is mentioned specimens have in all instances been seen and verified by the Society's referees—a precaution not without value even with such a well-characterized species; (2) what I have seen in the habitats which I have been able to visit during the last twenty years. The tale of its localities is no doubt in detail still far from complete, though the facts at present known probably give a fairly accurate picture of its general distribution.

It is not always easy to find, for it is often local and not abundant, and though in wet weather it makes itself conveniently conspicuous by climbing tree-trunks in its woodland habitats it is almost impossible to come by after two or three days without rain, nor are dead shells often found lying about even in the best places. Hence the fanciful idea that it climbs into the tree-tops in the spring and does not come down till the autumn—a good illustration of the difficulty of distinguishing fact from inference: under suitable weather conditions it may be found on the ground or crawling up the trunks from April to September.

Suffolk West v.c. 26. In his account of the mollusca of west Suffolk Mayfield [1] says, "has been found in several spots on the high lands south-west of Bury St. Edmunds. I have searched for it . . . but . . . have been unsuccessful." He gives Drinkstone Park and Hartest (Skepper) and Cockfield and Lavenham (Babington) as definite localities which are more south and east of Bury than south-west. No recent specimens have been seen but that some at least of these records are correct is attested by specimens labelled

[1] *Journ. Conch.*, 1906, XI, 337; 1909, XII, 276.

"Bury St. Edmunds" in Dr. H. Woodward's collection (which A. S. Kennard has) and in the York Museum and others in the Alder collection at Newcastle-upon-Tyne labelled "Whipstead" (1 on the map) which must be the Whepstead of modern maps, 4 miles south of Bury. There is no natural history museum at



Bury nor have I been able to hear of anyone who in recent years has collected mollusca in the neighbourhood. I have visited the area several times and have had in all six days' hunting, three of them ideal wet September days, mostly about Drinkstone, Hartest, and Whepstead, but without any success. The district is old, quiet, very rural, and highly cultivated; the soil being fairly calcareous boulder clay with a little chalk near Bury: it fizzles well with acid almost everywhere. The woods are oak, well looked after and infested with pheasants; the most promising are those at the agricultural college at Chadacre Park. A more likely place for *montana* is the old hedges of which there are a good many, mostly with a basis of ash. Cockfield is an unlikely-looking place and its citation as a locality may be due to the fact that C. Babington lived there and found *montana* somewhere in the district. Drinkstone Park has nothing better than an elderly ring plantation, recently felled, in which *E. obscura* was not uncommon with a stray dead *Bithinia tentaculata* which gave a momentary gleam of success. *Clausilia laminata* was found in several places and *Helix lapicida* in an old hedge by Hartest. There is, I think, no doubt that *montana*

used to live in the area and if so it is probably there still if anyone can hit on the place.

Herts v.c. 20. The next nearest locus connected to Suffolk by its occurrence in pleistocene gravels at Cambridge [2] is Aldbury (2) on the Chilterns, in Herts, 60 miles west and south, where Popple [3] found some dead shells near a beech wood in 1911: the district has been well worked and nothing more of the species has been seen so what the find means is uncertain.

Bucks v.c. 24. Following on the western escarpment of the Chilterns we come in 10 miles to the locality in the old beech woods by Green Hailey farm near Hampden (3) discovered by Oldham [4] in 1910 where in suitable weather *montana* is common in a limited area at the foot of the eastern slope of the woods.

Oxford v.c. 23. Another 9 miles south and west brings us to Sherborne (4) woods near Watlington and round here, in Home Wood (A. E. Ellis) and as far south as a wood by Nuffield (5) (A. E. Bradley), *montana* has been repeatedly found in the old beech woods on the western face of the Chilterns. In about 1850 A. M. Norman took "no less than 3 dozen from the trunk of a single tree". Several records specify "Henley" which probably means that the collector was stopping there when he found it in this area though there are some not impossible beech woods across the Thames, in Bucks, which I have examined without finding *montana*.

The species follows the Icknield Way no further, though there are some wooded gullies in the downs between Wantage and the White Horse that need looking into.

Hants North v.c. 12. In 1919 S. S. Pearce found verified specimens in a "wood near Ashford Bridge" which may or may not be the place about 3 miles north-east of Kingsclere and 16 miles south-west from Nuffield. In 1920 A. Gardiner got it a little to the west in a steep beech wood near Highclere (6). In the south-east of the vice-county it has been known for a long time in the famous beech hanger at Selborne (7).

Hants South v.c. 11. Nine miles south of Selborne and 3 miles south of Petersfield it lives in the old beech wood, Miscombe Hanger (8) [5] near Buriton on the Sussex border (C. E. Wright and H. Beeston), and in Ditcham Woods immediately adjacent (L. Dawes).

Sussex West v.c. 13. J. E. Cooper in 1912 found it in beech woods

[2] M. C. Hughes in Marr and Shipley's *Natural History of Cambridgeshire*, 190, p. 134.

[3] C. Oldham, *Trans. Herts. Nat. Hist. Soc.*, 1913, xv, 20.

[4] *Journ. Conch.*, 1911, XIII, 148.

[5] H. Beeston assures me that the locus is in Hants and not Sussex as stated in *Journ. Conch.*, 1912, XIII, 342.

at Slindon (9) near Arundel, 15 miles east of Miscombe, and his is its furthest verified locus towards the south-east, thought R. M. Christy reported that he had taken it at Hangleton near Chanctonbury Ring in 1879. Also in Heyshott Forest (beech) near Midhurst (C. W. Swanton).

Berks v.c. 22. C. P. Hurst[6] has found it in three beech woods on the north slope of the chalk downs by Rivar (10) and Ham, 5 miles south of Hungerford and 8 miles west of Highclere. When the Watsonian vice-counties were settled, these loci were partly in Berks and partly in Wilts South; they are now politically wholly in Wilts.

Gloucester East v.c. 33. In Dovedale, Blockley (11) on beech (T. E. Doeg,[7] not verified). Dovedale, 3 miles north-west of Moreton-in-the-Marsh, is a wooded combe facing north and in part a sophisticated beauty spot, at the top it is mostly an oak-hazel wood with some bracken and the earth not calcareous, below chiefly ash with some beeches and calcareous ground (oolite); there are a good many planted conifers and much sycamore. I visited the place in a cold bleak Easter and found very little, but I see no strong reason to doubt the record which is the most northerly one except Suffolk. The next record southwards in the Cotswolds is Humblebee Wood (12) at Charlton Abbots near Winchcombe, 10 miles south of Blockley and close to the well-known long barrow Belas Knap, a highly calcareous ash-beech-hazel wood.[8] Nine miles farther south is the splendid tract of old beech wood, with some ash on the western escarpment of the Cotswolds known variously as Birdlip Wood, Whitcombe Wood, and Cooper's Hill (13) and described indifferently as near Gloucester or Cheltenham. Here *montana* is abundant and extends throughout the similar woods to Cranham and Painswick (14). It also occurs in several of the old beech woods which are frequent on the steep sides of the valley of the River Frome (the Stroud valley) and its tributaries at least as far up as Edgeworth. From here it crosses the watershed and lives in the Thames basin in beech woods as far east as the north end of Hailey Wood, 4 miles south of Cirencester. At Sapperton it lives on the south side of the Thames and Severn Canal and therefore in *Gloucester West* v.c. 34, but nothing else seems to be known of it in the southern Cotswolds, though there are many steep beech woods round Uley and Dursley which look very likely places.

Somerset North v.c. 6. Several collectors have taken *E. montana* in the beech woods on oolite near Bath (15). About 20 miles south-

[6] *Journ. Conch.*, 1918, XV, 285.
[7] N. G. Hadden, *Journ. Conch.*, 1913, XIV, 108.
[8] *Journ. Conch.*, 1929, XVIII, 274.

west from here we come to the interesting loci on the Mendips (16) chiefly studied by F. A. Knight about fifty years ago. Here over an area extending from the main Axbridge–Bristol road about 2 miles eastward it lives in the scrubby screes of the mountain limestone at the foot of the small rocky cliffs, in dry weather being found among the stones and in the wet climbing up the bushes, mostly hawthorn and hazel: *Cyclostoma elegans*, *Helix lapicida*, and *Clausilia laminata* are also common. A picture of one of the places is given by Swanton.[9] Knight's chief locality, the Callar Cliffs, has now been destroyed by quarrying but *montana* can still (1933) be found among the north-facing cliffs above the farm Waterhead at about 600 feet. An excursion from Sidcot School once collected 35 specimens. It has also been found in similar places at Churchill to the north and in a wooded gully to the east, but it does not reach Cheddar Gorge itself nor does it occur in the big ash wood towards the foot of the Callar valley. It lives throughout the area in contact with limestone rock and with calcicole companions but the fine reddish soil among and beneath the stones is not markedly calcareous and does not usually fizzle with acid, which illustrates the mechanical strength and insolubility of mountain limestone compared with chalk or oolite. The area is also very dry and most of the *montana* places face north. It is instructive to compare this place with e.g. Birdlip Wood and to realize that, for all their differences in appearance, they are œcologically equivalent for our snail. The "Thorp Hill (J. W. Cundall)" of Roebuck's records I have not been able to identify.

Ten miles south of Bath and a mile or so north-west of Frome towards Mells H. F. Parsons got it in Vallis Vale (17), an ash wood on carboniferous limestone in a small gorge. Three miles south west of Frome Miss M. V. Lebour, in 1922, took it at Nunney (18), but she cannot now recall the exact place and I have twice explored the old hedges and such wood as exists without success; there is no beech wood there. About 7 miles south again brings us to the group of loci on the edge of the oolite near Bruton (19). W. Macmillan found it in the ash-hazel-spindle scrub on the bank of the steep road leading down into Milton Clevedon with hartstongue fern prominent among the plants; Swanton saw it there and I found it without difficulty in 1932 and 1937. In 1932 L. W. Grensted found it in an ash-thorn hedge on the Bruton–Frome road about a mile or two from Bruton where he happened to sit down for lunch and afterwards I came across it in two other places in the old hedges along the same road. It is recognized, botanically and conchologically, that old self-planted hedges are in

[9] E. W. Swanton, *The Mollusca of Somerset*, 1912, plate ii.

effect woods and perhaps *montana* would be found in them in other districts if it was looked for. Six miles east of Bruton, H. F. Parsons found it in a beech grove at the edge of the chalk downs at Long Knoll, Kilmington (20) which is now politically in Wilts. I failed to find it here in 1935, though *H. lapicida* and *Cl. laminata* were out on the trees in plenty but it was common on a wetter day in 1937.

Wilts South v.c. 8. The records are a beech wood at Erlestoke (22) 6 miles south-west of Devizes (C. Oldham) and Ashcombe Wood (beech) at Tollard Royal (21), 6 miles south-east of Shaftesbury (J. E. Vize, not confirmed, but quite likely).

Wilts North v.c. 7. Montagu's original locality (23) from which he described the species [10] is Tacklemore Wood near Lackham House where he lived, 3 miles south of Chippenham. It is essentially an ash wood with hazel undergrowth and a good deal of planting, on lower greensand and in most parts highly calcareous : *montana* was still there in 1930.[11] Montagu found it also in the beech woods in Bow Park, 2 miles to the east, which is probably the same locus as "Calne" which A. S. Kennard has from the collection of P. B. Mason. There is also an unconfirmed record for Roundway near Devizes (C. D. Heginbottom) : Oldham failed to find it in the old beech wood there.

So long as we are uncertain of their truth, it would be idle to discuss the significance of a number of printed records which have never been confirmed. Thus Parfitt [12] gives Axminster and Plymouth in his Devonshire list and Mansel-Pleydell, East Lulworth, in his Dorset list,[13] but there has been no verification nor do the localities mentioned present any likely-looking places, though it seems quite probable that the species lives somewhere in Dorset.

This survey leads to the clear conclusion that ancient woodland on calcareous soil is the characteristic, indeed the only, habitat of *Ena montana* in England. The ground is always, and generally highly, calcareous, the lime being provided indifferently by chalk (e.g. the Chilterns), oolite (e.g. the Cotswolds), mountain limestone (e.g. the Mendips), greensand (Lackham) or calcareous boulder clay (Suffolk). Owing to this calcicole habit, it is most commonly found in beech woods because in the area in which it occurs in the south of England beech is much the commonest basis of woods on calcareous soil. But it has no specific connection with beech : ash will do as well if the soil is right and so will the bushy scrub

[10] *Testacea Britannica*, 1803, p. 395.
[11] *Journ. Conch.*, 1932, XIX, 114.
[12] *Trans. Devon Ass.*, 1873, vi, 74.
[13] *L. F. W. Moll. Dorsetshire*, 1885, p. 42, but withdrawn in *Mollusca of Dorsetshire*, 1898, p. 14.

of the Mendips or the old mixed hedges in south Somerset, correspondingly it does not occur in beech woods on acid clay such as occupy the plateau of the Chilterns. The woodland too must be ancient, hence its habitats are often on very steep ground which can never have been cultivated, and though the actual trees present to-day may have been planted they occupy the site of primeval woodland or scrub. The old hedges in which it may live are simply little woods which have planted themselves on strips of uncultivated ground and similar hedges can also harbour such essentially woodland species as *Helix obvoluta* and *Clausilia rolphii*. It is in short distinctly anthropophobe and quite intolerant of cultivation or disturbance ; it is not found in modern beech or ash woods which have been planted on cultivated ground though many of these date from the middle of the eighteenth century, and we may surmise that its capacity for disposal is small since many of them are not far from ancient woods where it lives. Most of the loci are on hills, up to 800 feet in the Cotswolds. There is, indeed, no record of *montana* in the floor of a valley or near sea-level, presumably because ancient woodland does not occur in such situations. Favre [14] notices that in the Geneva district it is usually at about 2,000 feet and absent from the valleys. It may be that it really has a preference for dry habitats. Montagu's wood at Lackham has a good many wet places, but the other loci that I know are all distinctly dry. Perhaps because with us it is at the limit of its geographical range, it is never what one might call abundant even in the best places, and under the most favourable conditions. Knight was very pleased when he got 20 specimens in a day on the Mendips and though I have been in Birdlip Wood several times on ideal days I have never seen as many as 50 adults on one visit.

Diala capensis Bartsch.—Described in *Bull. U.S. Nat. Mus.*, 91, p. 123, pl. vi, f. 10, 1915, from Port Alfred ; a totally different shell from *D. capensis* Sowerby, *Journal of Conchology*, VI, p. 12, pl. i, f. 17, 1889, Durban Bay. I therefore propose to rename Bartsch's shell *Diala jordani*, after Mr. E. K. Jordan, an enthusiastic South African collector.

J. R. le B. Tomlin.

[14] *Mém. Soc. Phys. Hist. Nat. Genève*, 1927, xl, 215.

FURTHER NOTES ON LIMAPONTIA DEPRESSA (A. & H.) VAR. PELLUCIDA KEVAN.

By D. K. KEVAN.

(*Read before the Society, 11th February, 1939.*)

THE problems presented in a previous paper (1) with regard to the life history of this Nudibranch were the subject of further investigation, and its habitat on the Tyne Estuary was visited on various occasions from the time of its reappearance (3.12.33) to 12.7.34, by which time the life cycle had repeated itself and the mollusc had again disappeared from the saltmarsh.

Habitat. It was found that *L. depressa* var. *pellucida* was much more widely distributed in the areas of easy flooding, and that in suitable situations the species extended from the original habitat (Locus I) near the centre of the marsh almost round to the point of the spit of land. At this last station (Locus II) the shore sloped gradually upwards from the estuarine mud, and could be divided into three zones :—

Zone I :	To L.W.M.	Estuarine Mud.	*Fucus.*
Zone II :	L.W.M. to H.W.M.	Sand.	*Confervæ.*
Zone III :	H.W.M. to H.W.M. (Spring Tides).	Mud or Muddy Sand.	*Pelvetia* and *Vaucheria.*

Visits.

3.12.33. *L. depressa* had already reappeared (1).

2.1.34. *Locus I.* One egg-capsule only found.
Locus II.
Zone II : *Alderia modesta juv.* abundant ; *L. depressa* egg-capsules plentiful. Some were taken. Veligers free-swimming 6.1.34 to 10.1.34 but all died by 20.1.34.
Zone III : *L. depressa* on *Vaucheria.*

4.2.34. *Locus I.* *L. depressa* and *A. modesta* plentiful over all areas of easy flooding.
Between *Locus I* and *Locus II.* *A. modesta* frequent but *L. depressa* somewhat scarce.
Locus II.
Zone II : *L. depressa* and *A. modesta juv.* crawling towards Zone III. *L. capitata* left by tide from Zone I.
Zone III : *L. depressa* and *A. modesta* abundant, the former about half-grown. No adults nor egg-capsules seen.

18.2.34. *Locus I.* *L. depressa* abundant. Much larger. On *Vaucheria* as usual. *A. modesta* plentiful.
Between *Locus I* and *Locus II.* Ditto in suitable situations.
Locus II.
Zone I : *L. capitata* abundant on estuarine mud.
Zone II : *A. modesta* plentiful.
Zone III : *L. depressa* plentiful. *A. modesta* less frequent.

1.4.34. High Spring Tide. All habitats covered. Tide flows up centre creek very rapidly, the areas first to be flooded being *Locus I* and *Locus II* where *L. depressa* is always more plentiful.

13.5.34. Half Spring Tide, covering marsh up to *Locus I*. Wind very strong.

Locus I. *L. depressa* plentiful in places, but well hidden from wind in cracks among *Vaucheria* and under *Pelvetia* on windward edges of " hummocks ". *A. modesta* not noted.

Locus II.

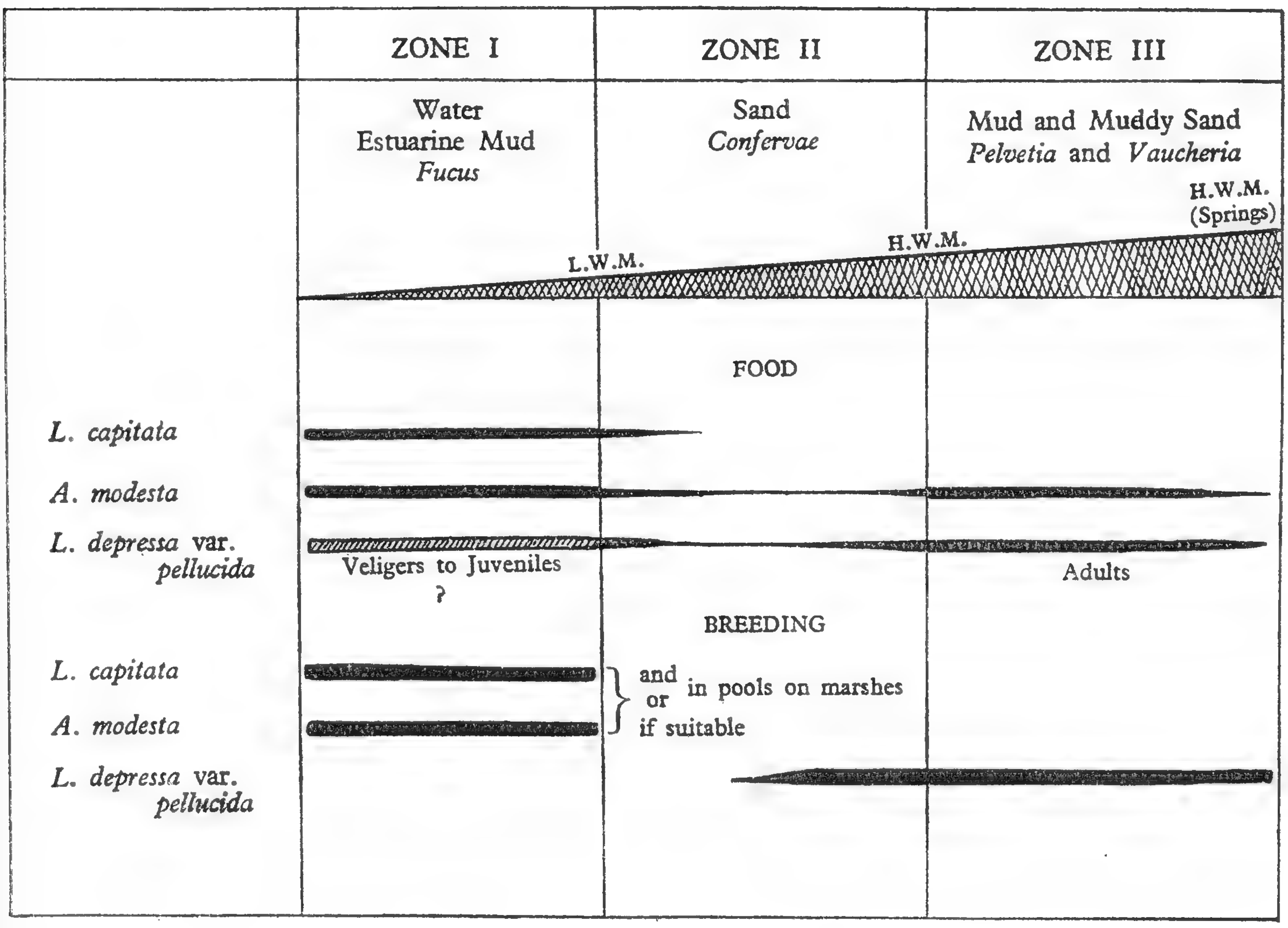
Zone I : *L. capitata* not seen. Probably buried.

Zone II : Nil.

Zone III : *L. depressa* more plentiful in similar situations to *Locus I*. Egg-capsules numerous. *A. modesta* not noted.

12.7.34. No sign of *L. depressa* or *A. modesta*. *Salicornia* growing rapidly, while *Vaucheria* much weaker.

From the above it is possible to suggest the following zoning in relation to food and breeding :—



Further visits were made on 2.12.34 and 9.12.34 when *L. depressa* had again reappeared in abundance—as also *L. capitata* and *A. modesta*—in their respective zones. Again on 24.3.35, as expected, *L. depressa* and *A. modesta* were very plentiful on the marsh, and on many occasions since then *L. depressa* has been noted on dates confirming the regularity of its appearance, development, and disappearance.

These investigations undoubtedly point to the strong probability of the life cycle of this Nudibranch occurring partly on the marsh

(for breeding) and partly in a true marine habitat (in its early stages), although conclusive proof of this is still required. Nor is it possible to make any categoric statement as to whether there are two more or less clearly defined breeding periods, or only one continuous period beginning in November or December and ending in May with two optimum periods included. This factor, being governed by climatic conditions and the consequent development of the food supply, might vary very considerably.

There is, however, one point which calls for comment. Dr. Pelseneer (2) states with regard to the habitat of *L. depressa*: "In each station *L. depressa* is living in the same natural conditions: brackish pools more or less isolated from the sea, and there related only by exceptional tides."

This tidal influence (i.e. Spring Tides) seems essential for *L. depressa*, but there are many isolated pools on the other side of the creek at Tyninghame Saltmarsh such as those above-mentioned, but these have not yet yielded any of this species. Also, at Aberlady (further westwards along the Forth) where an ideal habitat exists, Dr. Edith A. T. Nicol (3) who carried out an intensive investigation of the saltmarsh, found no trace of *L. depressa*. While this tidal influence seems equally essential for the development of var. *pellucida* the fact that it deliberately chooses the surface of the marsh in preference to pools must raise the question of its specific status. Such a marked difference in breeding habit may be much more than environmental. As to whether *L. depressa* var. *pellucida* is a distinct species, however, or merely a variety as at present described, can only be proved by a thorough anatomical investigation.

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(1) Kevan, D. K., "*Limapontia depressa* var. nov. in Scotland," *Journ. Conch.*, XX, p. 16.
(2) Pelseneer, Dr. Paul, "Bionomics of a Brackish-water Nudibranch: *Limapontia depressa*," *Journ. Conch.*, XX, p. 54.
(3) Nicol, Dr. E. A. T., "The Ecology of a Salt-Marsh," *J. of Mar. Biol. Ass. of U.K.*, xx, no. 2.

GIANT SQUIDS NEAR SCARBOROUGH.

By W. J. Clarke, F.Z.S.

During January of this year word reached me of the recent occurrence of a huge squid on the shore a few miles north of Scarborough. After long inquiry it transpired that the creature had stranded in October, 1938, at a point about half a mile north of Ravenscar. It was found by a local man named Shippey, who did not realize the importance of his discovery. The length, he said, was 16 feet, the tentacles being as thick as a man's arm. He cut out the beak and took it away as a curiosity, and afterwards the carcase was partially cut up and used as bait for fishermen's cod lines. With the assistance of Mr. E. A. Wallis I was enabled to get the loan of the beak, and sent it to the British Museum in the hope that possibly it might help to determine the species. Mr. G. I. Crawford of the Mollusca Department kindly replied :—

"I have no doubt from the size of the animal, and the size and form of the jaws that it is an *Architeuthis*, but I am not able myself to suggest what the species is and I do not think, with our present rather uncertain knowledge of this genus, that anybody could say with any sort of certainty."

In view of the extreme rarity of the occurrence of squids of this genus in British waters, it is very regrettable that no part of the animal could be secured which would help to establish its identity.

During the past two years many smaller squids have turned up in the Scarborough district. Most of these have been *Ommastrephes sagittatus* Lamarck, which is far the commonest of the larger squids on the Yorkshire coast. The following records came under my notice :—

Two at Scarborough, and one at Filey during 1936.

One at Scarborough South Sands, 35 inches long, 11th February, 1937.

One at Cayton Bay, 3 feet long, 17th February, 1937.

Thirteen at Scarborough South Sands, up to 3 feet long, 19th February, 1937.

Three at Scarborough South Sands, 21st February, 1937.

Two at Scarborough South Sands, 22nd February, 1937.

Six at Scarborough, up to 37 inches long, 23rd February, 1937.

One at Reighton Gap, 35 inches long, 4th March, 1937.

A single example of *Sthenoteuthis caroli* Furtado was stranded on the South Sands at Scarborough on 7th February, 1938. It measured 4 ft. 10 in. in length and is now preserved in the local museum.

Others which were unidentified include :—

One at Hayburn Wyke with tentacles 3 feet long, 1st January, 1938.

One at Scalby Ness 2 ft. 9 in. long, 12th January, 1938.

One at Filey 7 feet long on 30th December, 1937. May have been a small example of *Architeuthis* as it was said to possess a very small tail fin.

All these were cut up for bait as soon as discovered and no part of them was available for examination.

LAND AND FRESHWATER MOLLUSCA OF SUSSEX.

Since these notes were first commenced in 1917, many changes have taken place in the surrounding country. West Blatchington, so famous for its varieties of *Cepæa nemoralis* and *hortensis*, is now built over.

The locality for the large *Helicella virgata* on the roadside between Roedean and Rottingdean is destroyed.

Helicodonta obvoluta Müller.—Recorded from Bury Hill, near Amberley, in these notes for June, 1931, according to G. S. Stubbs is no longer to be found there owing to timber felling and building.

Lymnæa stagnalis, var. *variegata* Hazay, confined to one marsh drain at Lewes, appears to be now (1939) extinct, but specimens from thence are in my own collection and that of the Haslemere Museum. Swanton (*Zoologist*, 1915) gives another record in Sussex as Winchelsea, specimens collected there being in the Hastings Museum.

Cochlicella acuta Müller.—This species has extended its range from Saddlescombe and is now to be found at Patcham and just outside Hove. A very large specimen was taken by A. G. Stubbs in November, 1938, at Saddlescombe, measuring : height, 29 mm. ; breadth at thickest whorl, 5 mm. The largest shell recorded from there hitherto, by H. S. Toms, gave height 25·75 mm. Specimens of 19 mm. and 20 mm. have been frequently taken.

Amongst some *Pisidia* sent to C. Oldham for identification were specimens of *P. personatum* Malm. from a stagnant pond at Warnham, hitherto only recorded by R. Winckworth from Chichester who gave me specimens from there.

It may not be out of place to record here the adaptations of some mollusca of marine origin to fresh or brackish water.

Littorina rudis was found living in a freshwater pool about half a mile from the sea at Shoreham.

Scrobicularia piperata.—Shoreham, in tidal river about one mile from the sea.

Abra tenuis Wood.—Living in isolated slightly brackish pool ¾ mile from the sea at Shoreham.

J. G. DALGLIESH.

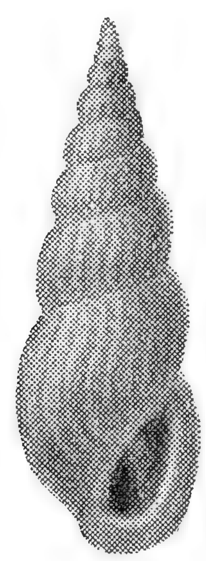
A NEW RISSOINA.

By J. R. le B. Tomlin.

Rissoina viaderi n.sp.

Shell long and very narrow, colour pale brown ; number of whorls about ten, of which the first three are smooth and opaquely white and form the protoconch ; the upper margin of each whorl after the protoconch is strongly impressed over the preceding whorl ; there is no spiral sculpture to be detected but the last seven whorls have regular, gently curving, outstanding axial ribs, whereof there are ten on the penultimate whorl ; on the body whorl the ribs curve in succession to the right and end up on the columella ; aperture oblong in shape ; peristome very strongly thickened.

Long, 3 mm. ; diam. max. vix 1 mm. Hab., Mauritius.



Rissoina viaderi n.sp. × 9.

This fascinating little shell has been awaiting description for some considerable time. It occurs sparingly in most batches of shell-sand from the Island of Mauritius, and I dedicate it with very great pleasure to Mr. R. Viader.

Mauritius has always been noted for its molluscan fauna, but there has been so much to attract in the way of larger species that, with the exception of von Martens, authors seem to have ignored the very small things. In the course of sorting over a large amount of material I have been greatly struck by the number of species common to Mauritius and Lifu, and by the extensive range of some of these tiny gastropods.

R. viaderi belongs to the typical section of *Rissoina*, but is so distinct by its narrowly elongate form and by its apparently constant colour that comparison with any known species is unnecessary.

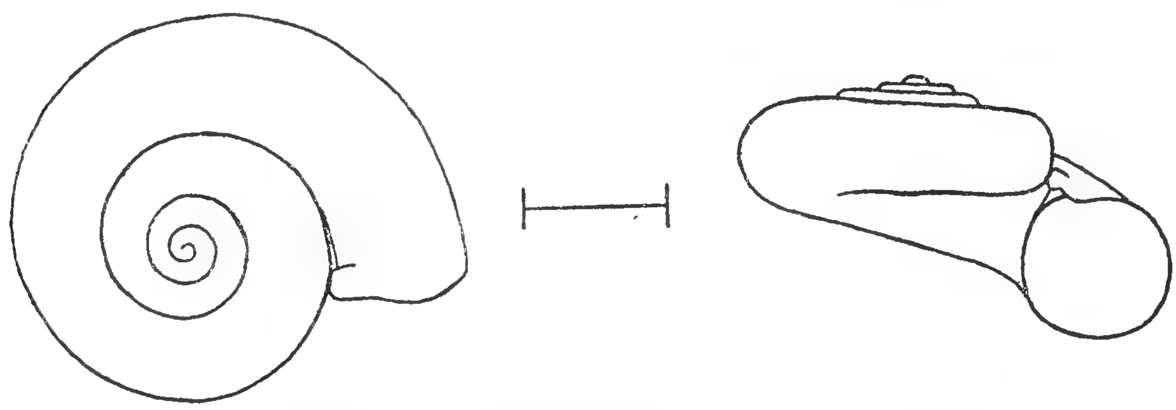
A NEW RHIOSTOMA FROM MALAYA.

By F. F. Laidlaw, M.A.

(*Read before the Society*, 11*th February*, 1939.)

Rhiostoma macalpine-woodsi sp.n.

Shell discoidal, widely umbilicated. Colour dark brown, with irregular zigzag, radial markings of white; no definite dark band at the periphery, and with fine, close growth marks. Spire scarcely elevated, whorls $4\frac{1}{2}$, increasing regularly, the last descending a little, and tending to become solute for the last 2 mm. of its course.



Aperture circular, not reflected nor thickened, with a notch above. On the dorsal side of this notch the margin of the peristome is produced to form an ear-like expansion, twisted backwards on itself, about 1 mm. in length, running inwards and impinging on the penultimate whorl.

Suture deeply impressed. Operculum not seen. Diam. max. 12 mm., height 6 mm.

Described from dead specimens from Sungei Siput, Perak, kindly obtained for me by Mr. and Mrs. Macalpine Woods. Type specimen in my collection. Examples deposited in British Museum.

Near *jousseaumei* de Morgan, but slightly smaller and less solid, more depressed, and with the last whorl not descending so steeply, and not so markedly disconnected.

It is unfortunate that no information is available as to the character of the operculum of either of these species. In the larger species of the genus a large percentage even of dead shells retain this structure, but I have looked in vain for it amongst the thirty specimens of the present species.

Though both *jousseaumei* and *macalpine-woodsi* differ from other species of the genus, both in their small size, and in the character of the tube, they are best left here until the operculum has been described.

LAND AND FRESHWATER MOLLUSCA OF THE CAVEHILL.

By Ranald MacDonald.

The Cavehill, one of the series of hills situated to the north of Belfast, has for many years been one of my favourite collecting grounds for both land and fresh-water mollusca. The area is for the most part barren moorland which is poor in mollusca, but in several places, notably the old quarry on the southern, Belfast and Castle Demesne on the eastern face we have very rich habitats. Unfortunately there are few streams and only one pond in the area. This last was formerly about 15 feet in diameter, but is now greatly shrunken in area and was at one time quite good for fresh-water species, while the streams are poor.

The areas may be described briefly as follows :—

1. The old chalk quarry which is mainly chalk cliffs overlain by basalt and old mounds composed of waste material now overgrown, as it is about 25 years or more since the quarry ceased working.

2. The Castle Demesne, situated to the east of the quarry : this has been cultivated in parts by planting bushes and making gardens, but large areas both open and wooded have apparently never been cultivated, at least not for a century or so. The rest of the hill is chiefly moorland except for one or two ravines on the eastern face, which runs as a series of cliffs for half a mile or more above the Castle grounds and Hazelwood and Bellevue Gardens.

The records are with the exception of three species my own ; these three marked * are from specimens collected by my friend Welch, who very kindly permitted me to make use of many of his notes a short time before his death :—

Acicula lineata (Drap.). Chalk quarry, on mounds among moss. Head of ravine above Hazelwood.

Carychium minimum Müller. Castle grounds and woods near Hazelwood, among dead leaves.

Columella edentula (Drap.). Talus below McArt's fort.

Lauria cylindracea (Da Costa). Face of quarry, at roots of plants on talus, also under stones on wall of Demesne and plentiful in all suitable places.

**L. anglica* (Fér.). Chalk quarry.

Acanthinula aculeata (Müller). Chalk quarry, var. *albida* ; also ravine above Hazelwood in roots of *Luzula* sp ?

**Cecilioides acicula* (Müller). Chalk quarry, on mounds.

Cochlicopa lubrica (Müller). Under stones, wood, among moss both at quarry and in Demesne.

Ena obscura (Müller). Face of quarry and on Demesne wall, a rare Antrim species.

**Punctum pygmæum* (Drap.). Chalk quarry, in moss.

Goniodiscus rotundatus (Müller). Common at quarry and in Demesne.

Arion circumscriptus Johnston. Under stones at quarry and in Castle grounds, also ravine above Hazelwood.

A. hortensis Fér. At quarry and common in Castle grounds.

A. intermedius (Normand). Under stones at quarry.

A. subfuscus (Drap.). Near McArt's fort, crawling about at 1,160 feet on grassy slope of cliff.

A. ater (L.). Very common, all areas, vars. *brunnea* and *atra*.

Clausilia rugosa Drap. Common at quarry and in a few places in the Demesne.

Trichia hispida (L.). Very common at quarry and in suitable places all along eastern slope of the hill.

T. striolata (Pfeiffer). Quarry, fairly common.

Arianta arbustorum (L.). Head of Carr's Glen among nettles.

Cepæa nemoralis (L.). Common at quarry, type and vars. *acuminata* Baudon and *libellula* Risso.

Helix aspersa Müller. Quarry, rare.

Retinella radiatula (Alder). Quarry, among moss; one sp. of var. *viridescenti-alba* Jeff.

R. pura (Alder). Quarry, among moss.

R. nitidula (Drap.). Head of ravine above Hazelwood.

Oxychilus alliarius (Müller). Carr's Glen in moss; woods of Castle grounds.

O. cellarius (Müller). Quarry, among moss and apparently very plentiful in many places, and in ravine above Hazelwood.

Vitrea crystallina (Müller). Quarry, in moss.

Vitrina pellucida (Müller). Plentiful in many places at quarry and in Castle grounds.

Agriolimax lævis (Müller). Under old pieces of decaying wood near Nora's Grave.

A. agrestis (L.). Common in several vars. as *nigra*, *reticulata*, and *pallida*.

Limax maximus L. Carr's Glen and Castle grounds, var. *ferussaci*.

L. marginatus Müller. Near quarry, on rocks and trees.

Hydrobia jenkinsi Smith. Pond at Nora's Grave above 500 feet contour.

Lymnæa truncatula (Müller). Pond at Nora's Grave and waterfall on face of quarry.

L. palustris (Müller). Pond at Nora's Grave.

L. peregra (Müller). Pond at Nora's Grave.

Ancylastrum fluviatile (Müller). At little streams running out of pond at Nora's Grave and Carr's Glen River.

Aplecta hypnorum (L.). Pond at Nora's Grave.

Planorbis spirorbis (L.). Marshy ground near old bridge over quarry tramway line.

Succinea pfeifferi Rm. Pond at Nora's Grave.

Pisidium casertanum Poli. Pond at Nora's Grave.

P. personatum Malm. Pond at Nora's Grave.

All records refer to living specimens.

My thanks are due to Mr. A. W. Stelfox, of the National Museum, Dublin, for his kindness in naming the species of *Pisidia*, and to the late Mr. R. J. Welch, for the use of his records.

POND AT SHEEP HIGH COTTAGES, EASTBOURNE DOWNS.

This pond, a field pond dug out in a corner of a field, is about 400 yards from Friston Pond. It holds water badly, usually drying up about June in most summers, filling again about October. Owing to its drying up it has become completely covered with *G. fluitans* and other grasses. In 1936, a wet summer, it held both *L. peregra* and *L. stagnalis*, as well as *S. lacustre* and *P. crista*. On 24th August, 1939, it was quite dry; there was no water and it could be walked over.

No living snails were found but scores of dead adult *L. stagnalis* were lying on the dried mud of the pond, no traces of any *L. peregra* were to be found. Have they died out in the interval ?

G. SHRUBSOLE.

THE BRITISH SPECIES OF LAMELLARIA.

By Nora Fisher McMillan.

(*Read before the Society, 2nd April,* 1938.)

In Winckworth's list of British marine mollusca (*Journ. Conch.*, XX, 217–252, 1932) two species of *Lamellaria* are mentioned. These are *L. perspicua* (Linné, 1758) and *L. latens* (Müller, 1776). The former species appears to be widely distributed in Britannic waters, but *latens* is included on the strength of three Northumbrian specimens identified by Dr. N. J. Odhner (1,[1] pp. 49–50). *L. latens* has been generally misunderstood, and as I have had opportunities of observing both species in a living state, it is hoped that the present paper will throw some light on the subject.

Lamellaria perspicua (Linné) as understood by British workers includes both *perspicua* proper and *latens*. The true *perspicua* is well figured by Odhner (1, Fig. 1) and is the form once regarded as the female, *latens* being considered the male. Odhner has shown that no sexual dimorphism exists in either species and that the depressed " male " shells belong to *latens*.

I had for some time suspected that the *Lamellaria* which occurred at Greenisland, Co. Antrim, comprised two distinct species, but at first could not obtain specimens of *latens* for comparison. The Greenisland specimens, which were all taken by shore-collecting, could be divided into two clearly differentiated groups thus :—

(*a*) Usually fairly large, animal 20 mm. long or over. Colour, pale indefinite purplish- or lilac-grey, occasionally microscopically frosted with tiny white dots. Shell convex, boat-shaped, spire more or less raised.

(*b*) Smaller, animal ca. 10 mm. in specimens measured (few only). Colour, light sandy-brown minutely freckled with black. Sometimes deep yellowish-buff, speckled with black. Shell almost flat, spire not raised at all, and outline rather oblong when laid flat with mouth upwards.

Shells from (*a*) agreed perfectly with the typical *L. perspicua* as understood by British conchologists. Those from (*b*) agreed well with the shell figured by Odhner (1, pl. 1, fig. 6) as *latens* (Müller).

In November, 1936, I sent specimens of both forms (animals in spirit as well as shells) to Dr. Odhner, and he confirmed my tentative identifications. He also wrote, " The difference of colour is, I think, a good distinguishing mark." Later, in November,

[1] These numbers refer to References at end of Article.

1937, I sent some more material to Dr. Odhner, and he identified *latens* from Plymouth (collected by Dr. H. B. Moore, October, 1937, one specimen), further Greenisland specimens (collected 26th December, 1936) and a shell from Durham (Liverpool Museums Collection). By the kindness of the Dublin Museum authorities I have been enabled to examine their British *Lamellaria*. Details are as follows :—

Lamellaria perspicus (L.)

Locality.	*Size of Shell* (in mm.)	*Notes.*
Ballycastle, Co. Antrim .	3 by 2 . .	G. W. Chaster (c.).
Portmarnock, Co. Dublin	10 by 7 . .	Waller Coll.
Baltimore, Co. Cork .	almost decalcified	A. R. Nichols (c.).
Bantry Bay, Co. Kerry .	10 by 7 . .	
Salthill, Co. Galway .	6 by 4 . .	W. W. Walpole (c.), (Waller Coll.).

In addition there are eight unlocalized shells, four from the Waller Collection. These vary in size from 11 by 8 mm. (three shells) to 15 by 11 mm. (two shells).

Lamellaria latens (Müller).

Bundoran, Co. Donegal .	v. small . .	
Salthill, Co. Galway .	7 by 5 mm. .	W. W. Walpole (c.), (Waller Coll.).
Cromarty, Scotland .	9 by 7 . .	Mrs. J. Scharff (c.).

There are also two unlocalized shells ; these measure 4 by 3 mm. and 6 by 4 mm.

I think that *latens* will be found to be widely distributed. Marshall in 1911 (2, p. 181) says " The figure of *Lamellaria latens* Müll. in Sars' work also well represents our *lata* form [i.e. var. *lata* Jeff. of *perspicua*], which I take to be the same species ; the figures are identical," and gives the following reliable localities for this var. *lata* : Sutherlandshire, from haddocks ; Jersey ; Penzance ; Torbay ; Weymouth ; Mayo ; Sligo ; Portrush ; and Caldy Island.

From Plymouth Dr. Lebour (3, pp. 164–6) records two species of *Lamellaria* Echinospira larvæ in the plankton, so it is particularly satisfactory to have adults of both species identified by Dr. Odhner.

From the Isle of Man only *perspicua* is recorded by Moore (4, p. 182), but I am now able to add *latens* to the fauna, owing to the kindness of Mr. J. R. Bruce, M.Sc., who sent me a consignment in April, 1938. These included both speckled and self-coloured animals in about equal numbers, and from three of each kind the shells were extracted. The self-coloured animals all possessed typical *perspicua* shells, and the speckled specimens depressed

latens shells. All were collected at L.W.O.S.T. in Port Erin Bay, mostly upon the compound ascidian *Trididemnum tenerum* (Verrill). Mr. Bruce also writes, " I examined all of them *alive*, and can say that *all* the unspeckled ones were of a nearly uniform lilac-grey tint. The speckled ones varied in ground-colour from pale fawn to very pale grey, but the speckling always distinguished them. The speckles were dark, almost sepia, above, inclining towards cinnamon at the edges of the mantle." Little difference in size was observed between the self-coloured and speckled animals, but the smaller specimens (in the sample sent) were usually speckled.

Colgan (5, pp. 110, 113) records *Lamellaria* sp. from the Malahide River, Co. Dublin, as " Yellow with black dots " which suggests *latens*. In a later paper (6, p. 411) he states, " In colour this species [*L. perspicua*] varies in Dublin from orange to dull yellow or grey, specimens taken at Malahide on *Halichondria panicea* closely assimilating to the colour of that sponge." From this it would seem that both species occur in Co. Dublin.

Without much more material I am loath to generalize, but on the basis of my Greenisland observations (which cover a period of just over three years) I suggest that, apart from the difference in shell-form, *latens* is *always* smaller, and *usually* of a sandy-brown or light yellowish-buff colour, minutely freckled with dark brown or black; *perspicua* (adult) is usually larger, and *always* of some shade of lilac-grey. *Not* speckled and *never* sandy-brown.

These statements may not hold good everywhere, but may serve as a rough guide. Dr. Lebour's coloured figures of the two Plymouth forms of *Lamellaria* (3, pl 1, fig. 10*a* and pl. 2, fig. 8) agree fairly well; *perspicua* is shown as an indeterminate grey, with yellowish spots and little dark-coloured dots; while *latens?* is figured as pale drab, speckled with small dark dots and some reddish-yellow spots also. Thus, except for the dark dots in *perspicua*, which I have not observed in any Greenisland specimens, both species as found in Plymouth fit in with the suggestion that the " basic " colour of *perspicua* is some shade of grey or lilac-grey, and that of *latens* a yellow-drab or pale buff. The Manx specimens agree also with this colour-distinction on the whole, for the pale grey examples of *latens* were easily distinguished by the dark speckles. I have not yet seen an unspeckled specimen of *latens*.

Mr. W. Fowler tells me that he got two brick-red *Lamellaria* (sp. not det.) in the Neyland-Milford Haven Estuary in December, 1937. At Greenisland I have seen no colour-variation.

The only other species of *Lamellaria* which has any claim to inclusion in the Britannic fauna is *Lamellaria pellucida* (Verrill) var. *gouldi* (Verrill), of which four specimens have been obtained

off the south-west coast of Ireland, on the Atlantic Slope (Massy, 7, p. 300). It is a North American species, but has already been recorded from European waters by Vayssière, who examined Biscayan specimens (8). An account of the first Irish specimen taken has been published by Mr. G. P. Farran (9), and another of the specimens recorded by Miss Massy—that from " Series S.R. 36c—T., 108–120 fms.—1 " is now in the National Museum, Dublin. I am indebted to Mr. A. W. Stelfox for particulars of this specimen.

In conclusion I would like to thank Mr. J. R. Bruce, Dr. Marie V. Lebour, Dr. H. B. Moore, Mr. A. W. Stelfox, and in particular Dr. Odhner for their help.

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(8)[1] Vayssière, A., *Ann. Univ. Lyon.*, xxv, p. 243.
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LITTORINA SAXATILIS NIGROLINEATA GRAY.

By N. F. McMillan.

(*Read before the Society, 10th December, 1938.*)

During the last two years I have paid a good many visits to Anglesey and was interested to find how widely-spread *Littorina saxatilis nigrolineata* appears to be in that county.

Jeffreys describes this form as " Ribs flattened : colour yellow, with purplish-brown furrows ", but Marshall (*Journal of Conchology*, vol. 9, pp. 121–2) states that " it is variable in size, colour and shape, though usually oval ". He adds that " it is not always

[1] I have not been able to see this reference, and have quoted it from Farran's paper (9).

yellow, being sometimes red or brown, and the purple furrows are often absent", but that its prevailing character is the coarse and flattened ribs. Jeffreys' var. *compressa* is merely a yellow, bandless form of *nigrolineata*.

The banded *nigrolineata* I have not seen in North Wales, but the yellow bandless form occurs in abundance in a good many Anglesey localities, as well as at Porth Dinllaen, Lleyn, Caernarvonshire. There it was abundant and large and only a very few small specimens of the ordinary form were obtained.

In Anglesey *nigrolineata* predominated at Cemlyn Bay, was abundant at Trearddhur Bay, and occurred sparingly, outnumbered by the type-form, at Traeth Bycan, N. of Benllech Bay. At Porth Penrhyn-Mawr it completely dominated the *Fucus vesiculosus* zone, straying neither above nor below this zone, although the ordinary form occurred abundantly on other parts of the shore. The *nigrolineata* specimens were very much larger than those of the ordinary form. This tendency to hug the *Fucus vesiculosus* zone was even more clearly shown at Gored, on Beddmanarch Bay, where large fine examples were very abundant, and where the ordinary form was represented only very sparingly.

At Penmon, in the S.E. corner of the island, a few specimens, not very well-marked, were got on the old pier, with many yellow examples of the normal form, but on a large isolated rock at Trwyn y Penrhyn, W. of Penmon, I found *nigrolineata* very abundant but small at the top of the *Fucus vesiculosus* zone, and even ranging above it a little.

There does not seem to be any common factor for all these localities; Gored and Porth Penrhyn Mawr, where the finest specimens were obtained are both flat, sheltered, and rather muddy shores, but Cemlyn and Porth Dinllaen are both exposed rocky coasts, yet *nigrolineata* was dominant at both places. In every case observed so far, however, it only occurred in the *Fucus vesiculosus* zone.

In N.E. Ireland I have never collected *nigrolineata*, and there is no Irish record of it, so far as I know.

An outlying locality for the form is that of the island of Barra, in the Outer Hebrides, where in July, 1937, I took a few live specimens of the yellow bandless form on rocks just south of Traigh Mhor.

THE GENUS PLESIOPHYSA P. FISCHER.

By J. Bequaert and W. J. Clench.

(*Read before the Society, 11th February, 1939.*)

Through the kindness of Dr. F. Haas, we have been privileged to examine the Brazilian *Physa ornata* (Haas), tentatively referred to *Plesiophysa* by the author owing to the spiral engraved lines of the shell. We find that the radula of this snail is as described by Bland and Binney and by P. Fischer for *Plesiophysa*. Since Thiele (1931, *Handbuch d. Syst. Weichtierk.*, 2, p. 475) left the systematic position of *Plesiophysa* undecided we wish to discuss it somewhat in detail. Attention is called particularly to the need for further information on the occurrence and distribution of these snails in the Lesser Antilles and northern South America.

Plesiophysa P. Fischer.

Bulinus sub-genus *Plesiophysa* P. Fischer, 1883 (February), *Manuel de Conchyliologie*, pt. 5, p. 509. Monotypic for *Physa striata* d'Orbigny, 1841 = *Plesiophysa pilsbryi* Aguayo, 1935 = *Physa* (*Plesiophysa*) *guadeloupensis* Mazé, 1883.

Fischer defined this group very briefly : " Coquille assez courte. Dent centrale de la radule portant 5 cuspides dont la médiane est la plus longue." To this should be added the peculiar sculpture of spiral engraved lines cutting through the growth-striæ. The shell is sinistral and similar in shape to *Physa* and *Bulinus*. The radula, studied in *P. ornata* Haas (Fig. 1), is totally different from that of the *Physidæ*, being essentially as in *Planorbidæ*, *Lymnæidæ*, and *Ancylidæ*. It consists of a series of straight, horizontal rows of relatively few teeth ; the lateral teeth are large and tricuspid, without the accessory plate of the *Physidæ* ; the marginals are transverse and multicuspid. The centrals, however, are quite characteristic : while they have a relatively narrow, slightly emarginate base and evenly convex top, the cutting edge is divided into five cusps ; of these the median is very large, the next pair much smaller, but distinct, and the outermost pair very small and easily overlooked. In the *Lymnæidæ* the centrals are unicuspid ; while in the *Ancylidæ* and the *Planorbidæ* known thus far they are bicuspid. Since both the *Lymnæidæ* and *Planorbidæ* contain sinistral, *Physa*-like snails, the position of *Plesiophysa* remains problematical. Until more of the soft anatomy is known, we place it in the *Planorbidæ*, where it will form a distinct sub-family *Plesiophysinæ*. This will express our opinion that *Plesiophysa* is not only generically

distinct from the Old World *Bulinus*, but not even directly related. It may well represent an old ancestral stock from which both *Lymnæidæ* and *Planorbidæ* were derived, through reduction of the cusps of the centrals. *Plesiophysa* is known at present from the West Indies (definitely from Guadeloupe, St. Martin, and perhaps Barbados; very doubtfully from Martinique) and north-eastern Brazil (States of Parahyba and Pernambuco). Four species described as *Physæ* are referable to it, but only two of the West Indian forms appear to be specifically distinct.

Plesiophysa guadeloupensis (Mazé).

Physa striata d'Orbigny, 1841, in R. de la Sagra, *Hist. de l'île de Cuba, Mollusques*, 1, p. 192, pl. 13, figs. 14–16 (Martinique or Cuba). Sowerby, 1873, *Conch. Icon.*, 19, *Physa*, pl. 8, figs. 64 *a–b* (d'Orbigny's type in the Brit. Mus.). Clessin, 1885, *Syst. Conch.-Cab.*, 1, Abt. 17, p. 239, pl. 36, fig. 9 (copy of d'Orbigny's figure). H. Crosse, 1890, *J. de Conchyl.*, 38, p. 263. Not *P. striata* (Menke), 1830; nor of Lea, 1864.

Bulinus (*Plesiophysa*) *striata* P. Fischer, 1883 (February), *Manuel de Conchyliologie*, pt. 5, p. 510.

Physa (*Plesiophysa*) *striata* Mazé, 1883, *J. de Conchyl.*, 31, p. 31 (Guadeloupe: rather rare in three sets of pools of cold water: Pointe-à-Pître, mare Guillaume; Morne à l'Eau, mares du Morne Jensolen; Moule, mares des habitations Caignet, Lécluse, etc.).

Physa sp. Bland and Binney, 1873, *Ann. Lyceum Nat. Hist. New York* 10, p. 225, pl. 11, figs. 2–4 and 9 (Pointe-à-Pître, Guadeloupe; specimen collected by H. Schramm).

Physa (*Plesiophysa*) *guadeloupensis* "P. Fischer" Mazé, 1883, *J. de Conchyl.*, 31, p. 30 (Guadeloupe: Dolé, bassin de la Digue, altitude 223 m., temp. 30° to 31° C., and Massif de la Soufrière, morne Goyavier, bassin Beauvallon, altitude 957 m., temp. 34° C.; with brief description of the animal, but without reference to Bland and Binney); 1890, *J. de Conchyl.*, 38, p. 30 (St. Martin: Étang aux Huîtres; and Étang de Simson).

Physa (*Plesiophysa*) *guadalupensis* P. Fischer and Crosse, 1886, *Miss. Scientif. Mexique, Moll. Terr. Fl.*, 2, p. 82 (with reference to Bland and Binney, 1873).

Plesiophysa pilsbryi Aguayo, 1935, *Mem. Soc. Cubana Hist. Nat.*, 9, p. 121 (new name for *P. striata* d'Orbigny, 1841).

Physa (*Plesiophysa*) *pilsbryi* (Clench), 1936, *Mem. Soc. Cubana Hist. Nat.*, 10, p. 341, pl. 25, fig. 5 (copy of d'Orbigny's figure).

The only authenticated localities of this snail are in Guadeloupe and St. Martin. It is quite certain that it does not occur in Cuba. The alternate locality "Martinique", cited with the original

description of *P. striata*, is extremely doubtful, since F. de Candé, who sent the type to d'Orbigny, also collected in Guadeloupe. In any case, neither Mazé (1874, *J. de Conchyl.*, 22, p. 158) nor G. Bordaz (1899, *Bull. Soc. Hist. Nat. Autun*, 12, pt. 1, pp. 165–184) list this snail from Martinique.

The Philadelphia Academy of Natural Sciences has two specimens of a *Plesiophysa*, collected by H. Schramm at Pointe-à-Pître and probably part of the lot sent to Bland and Binney. One of these specimens agrees well with their figure of the shell, although we have no way of proving that it is the same specimen. The measurements of these snails are :—

Height, 9·7 mm. ; greatest width, 6·0 mm.
„ 7·0 mm. ; „ „ 5·8 mm.

According to a line drawn beside the figure, Bland and Binney's snail measured about 7·5 mm. in length.

We are unable to find reliable differences between the Pointe-à-Pître snails and d'Orbigny's figure of *P. striata*, which seems to be conspecific with Bland and Binney's snail ; d'Orbigny's type measured 6 mm. in height and 4 mm. in greatest width. Since d'Orbigny's name is preoccupied, we believe the species should be called "*guadeloupensis* Mazé". That name was, in our opinion, validly proposed by Mazé in 1883, since he gave a brief description of the animal, though not of the shell, using a manuscript name given by P. Fischer. If it were dated from Fischer and Crosse's publication of 1886, where it is backed by a reference to Bland and Binney's description and figures of 1873, the name would no longer be valid, being then antedated by Clessin's *Physa guadeloupensis* of 1885. So far as we can learn, P. Fischer never published a formal description of the snail.

Physa guadeloupensis "Grateloup" Clessin, 1885, *Syst. Conch.-Cab.*, 1, Abt. 17, p. 291, pl. 42, fig. 12, is one of the *Physidæ* and apparently a synonym of *Physa cubensis* (Pfeiffer).

Plesiophysa granulata (Sowerby).

Physa granulata "Shuttleworth" (Sowerby), 1873, *Conch. Icon.*, 19, *Physa*, pl. 5, fig. 39 *a–b* (Barbados ; type in Brit. Mus.). E. A. Smith and Feilden, 1891, *Ann. Mag. Nat. Hist.* (6), 8, p. 256 (Sowerby's type).

The original description says that the shell is "very minutely granulated". Smith and Feilden are more definite : "The close spiral striation of this species, being crossed by the lines of growth, has a minutely sub-granular appearance. It is not apparent to the

naked eye, but is distinctly visible under a simple lens." The type originally came from the Cuming Collection, which, as Smith and Feilden point out, is "somewhat notorious for errors of locality". The species has not been taken again in Barbados, where its presence should be confirmed. At the Academy of Natural Sciences are two labelled "*Physa granulata* Shuttleworth", from the Swift collection and with the locality "Barbados". They came probably from the same source as Sowerby's type, and agree with his figure in having a very deep suture, giving to the shell a somewhat scalariform appearance. This seems to distinguish *granulata* from *guadeloupensis*, and we accept it at present as a distinct species, pending a study of larger series from the Lesser Antilles. The sculpture consists of uniform, engraved, regularly beaded, spiral lines. The measurements are :—

Height, 5·2 mm. ; greatest width, 3·8 mm.
,, 5·0 mm. ; ,, ,, 3·3 mm.

Plesiophysa ornata (Haas).

Physa (?*Plesiophysa*) *ornata* Haas, 1938, *Archiv. f. Molluskenk.*, 70, p. 48, figs. 5–6 : type locality : Açude Ligeiro, Serra Branca, Municipio São João do Cariry, State Parahyba ; also from Açude "da Pia" between Patos and Sta. Luzia, State Parahyba ; Açude "Humaytá", Alagão Monteiro, State Parahyba ; Açude "do Sacco" near Villa Bella, State Pernambuco ; all Brazil.

We have studied three paratypes from Alagão Monteiro and two paratypes from between Patos and Sta. Luzia. *P. ornata* is more elongate than the West Indian species, with less convex whorls. The measurements given for the type are : Length, 9 mm. ; greatest width, 5·3 mm. ; aperture, 5·6 by 3·3 mm. The radula is described and figured in this paper (Fig. 1). It will be noted that, while the central and lateral of *P. ornata* are similar to those figured by Bland and Binney for *P. guadeloupensis*, our outer marginal is very different. We surmise that Bland and Binney missed the true marginal and figured instead one of the transitional teeth leading from the true laterals to the true marginals.

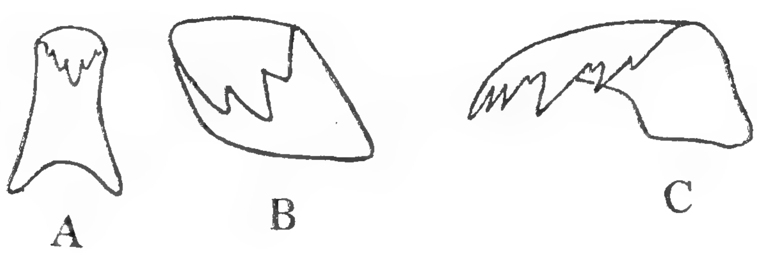

FIG. 1.—Radular teeth of *Plesiophysa ornata* (Haas). A, central; B, innermost lateral ; C, outermost marginal.

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN & IRELAND.

(*Continued from p. 150.*)

MARINE RECORDER'S REPORT, 1938.

During the past year many valuable lists of species, many of them common, have been sent in. People seem to understand now that these lists of common species are wanted; I have even been able to insert *Patella vulgata* in its map for Regions XIV and IXb, thanks to Dr. Jackson and Mrs. Morehouse; but it is still wanting in XV, XVI, XI, IVa, and IVb! Dr. N. B. Eales and Miss K. M. White have sent in a further list for the Isle of Man (Region X). This includes *Tonicella marmorea*, *Tricolia pullus pictus*, *Lacuna parva*, *Lacuna pallidula*, *Cingula semistriata*, *Onoba semicostata*, *Cingula cingillus*, *Alvania cimicoides*, *Trivia monacha arctica*, *Acteonia cocksii*, *Goniodoris nodosa*, *Goniodoris castanea*, *Facelina longicornis* and *Heteranomia squamula*. These were for the most part new. Mr. G. C. Spence made a list of 24 species found in June at Llanbedrog (Region X); of these, 4 species, *Modiolus modiolus*, *Tellina tenuis*, *Mya truncata* and a dead valve of *Psammocola depressa* had not been entered on the maps. Mrs. Morehouse sent very full lists of species for Region VIII covering observations made at Prussia Cove, Sennen Cove, Kynance Cove, Marazion and Tresco. These although not new were of value for confirmation.

Mr. W. Fowler took *Mytilus galloprovincialis* at Padstow, this is an extension of this species in Region IXa. He mentions that he found several *Gyroscala commutatum* at Pendine IXa, eight years ago; this is of interest as the writer has been able to record several specimens at Helford.

At Pendine Mr. Fowler found *Clathrus clathrus*, *turtonis*, *trevelyanus*, and *clathratulus*. At Milford Haven he took *Acanthochitona communis*, *Lepidopleurus cancellatus*, *Lamellaria perspicua* and *Lacuna crassior*; some of these were new for IXa.

Mr. F. H. Ludlam found *Clathrus clathratulus* at Falmouth.

Mrs. McMillan sent further particulars of the range of *Cantharidus exasperatus*, *Patella depressa* and *Patella athletica*.

Mr. W. F. Lloyd James has sent long lists for Milford Haven, Newport, and St. Bride's Bay, Pemb., 54 records in all; as Region IXb does not seem to have been a popular one, many of these were new.

At Plymouth Mr. H. Moore found *Simnia patula* and *Tritonia plebeia* on *Alcyonium digitatum*. At another station in the same district these species occurred with *Gephyropsis dohrni* (Dalyell) and *Eunicella verrucosa*. The distribution of *Simnia patula* seems to be scanty and discontinuous.

Mrs. Morehouse has again given much help by her holiday in West Ireland. For Region XIV, Donegal and Sligo she sent in a list of many species, 25 of which were not on the maps, as we had no recent first-hand evidence for them. This included *Janthina britannica* at Trawalna Strand.

The only observations of the Recorder himself of particular interest were upon *Onchidella celtica* on the north coast of Cornwall. The metropolis of this species is evidently here, extending from near Perranzabuloe to Bude. It is very common at the latter place and at Trevone and Porth near Newquay. It seems to live from near low water to half tide on the shady side of rocks. It is seldom found on rocks covered by large algæ, preferring those covered with small growth, *Mytilus* and *Balanus*. The old records of this species, at or above high-water mark, must be errors. The only other certain record for this animal is from Mr. Pike in Jersey at L'Etac.

It would be a help if observers when sending in records of *Trivia monacha* would state whether the form they had found was spotted, i.e. *T. monacha monacha* (da Costa) or unspotted, i.e. *T. monacha arctica* (Montagu). This is of importance; for example at Oban the latter is the only form found. Since this was written Dr. J. W. Jackson has sent in a list of dead shells

from the Barricane Beach, North Devon, of these *Balcis alba* (da Costa) and *Irus irus* (Linné) had not been listed for this place. There were 41 species in all.

CURATOR'S REPORT.

During the past twelve months attention has again been paid to the J. W. Taylor Collection of British Land and Freshwater Shells. Many specimens have been mounted in glass-topped boxes, and are now in a much better condition for viewing. Among the shells thus mounted are many species of *Helix* and *Lymnaea*.

YORKSHIRE CONCHOLOGICAL SOCIETY.

Forty-second Annual Report, 1938.

The officers for 1938 are :—

President : W. Thurgood, Leeds.
Vice-Presidents : H. C. Versey, D.Sc., F.G.S. ; D. Fisher.
Council : J. H. Lumb ; J. C. North, F.R.P.S.L. ; Miss E. Dufty ; J. R. Dibb, F.R.E.S. ; J. D. Firth, F.L.S. ; A. Smith.
Hon. Treasurer and Recorder : H. J. Armstrong, Leeds.
Hon. Secretary : E. Dearing, Elland.

Ten meetings have been held since the last Annual Meeting.

The joint meeting with the Parent Society was held in Leeds in November last, and proved very satisfactory.

An Exhibit meeting in December marked the close of the 1937 programme.

Meetings have taken place as follows in 1938 :—

8th January : General Exhibits by Members.
5th February : Special Exhibits of *Nucella*, *Littorina*, and *Pecten* ; and Short Papers.
5th March : Presidential Address by W. Thurgood.
9th April : Joint Meeting with the Conchology Society of Great Britain and Ireland at Manchester Museum.

Four Field Meetings have been held during the summer, but with disappointing attendances.

In May Woodhall Bridge, near Collingham, was visited with fairly encouraging results.

In June members joined the Y.N.U. Excursion to Askern and Shirley Pool, a report of the meeting has been published in *The Naturalist*.

An excursion to Newthorpe Quarries in July was arranged jointly with the Leeds Co-operative Naturalists' Club.

In September a field meeting to Agbrigg was attended by only three members. This was a joint meeting with the Y.N.U. Conchological Section, The Wakefield Naturalists' Society, and The Barnsley Naturalists' Society. Probably the inclement weather was the cause of the poor attendance.

There are three meetings to complete the 1938 Syllabus.

It is with profound regret that we have to mention the death of T. W. Saunders, of Doncaster.

Membership now stands at 21.

E. Dearing,
Hon. Secretary.

ANNUAL REPORT OF THE LONDON BRANCH.

The usual nine meetings have been held at the Cripplegate Institute, Golden Lane, E.C. 1, at each of which a fairly good attendance has been maintained.

It is pleasant to record that Mr. A. S. Kennard, A.L.S., again occupied the chair.

The Syllabus arranged was again of a diversified nature, and included such instructive subjects as "Preparing and Mounting Radulæ, Preservation of Material, etc." and "Methods and Care in Making and Keeping a Collection".

Among other items were "Non-Marine Shells of San Domingo", "Species of Physa introduced into Britain", "Clausiliidæ of Cyprus", and "British Pholadidæ". These special items were supplemented by notes on various genera such as *Thracia*, *Siphonaria*, and *Melanopsis*.

Exhibits have been good and have added in no small way to the interest of the meetings.

Altogether the 1937–8 session has had equal success with preceding years.

GUY L. WILKINS,
Hon. Secretary.

REPORT OF THE NORTH STAFFORDSHIRE BRANCH.

MESSRS. J. and W. Hill and H. Emmett made many excursions in search of mollusca during 1938. As may be expected, owing to the drought, land shells were hard to find. However, the Hill brothers report having taken several *H. hortensis*, very depressed shells, the most characteristic is quite flat, and coiled like a *Planorbis* with expanded mouth and trace of umbilicus. A photograph of it will be taken. *Helix arbustorum* with band formula 00340 was taken at Consall, *H. striolata*, var. *alba*, at Leek Wharf; other interesting species of land shells include *A. aculeata*, *C. columella*, *H. excavata*, and *H. hortensis*, var. *arenicola*. Freshwater mollusca obtained include *B. tentaculata* from a brook near Endon, tall shells, with whorls almost scalariform. In the canal at Milford few *B. leachii* occurred, it was far from common and after a long search only eight specimens were obtained. I can record *P. jenkinsi* from new localities including both ponds and streams, also some very fine specimens of *P. corneus* from Trentham. Quite recently I sent a few slugs (*Milax*) for determination to Mr. A. R. Waterston, including one specimen that I hoped would prove to be a new species to the Staffordshire list, viz. *Milax gracilis* (Leydig). This Mr. Waterston has confirmed.

I regret to report that we have lost by death one of our members, J. H. Goodson, who was a good field worker, both as conchologist and botanist.

B. BRYAN,
Hon. Secretary.

655th Meeting (Joint Meeting with the Yorkshire Conchological Society), held at Leeds University, 13th November, 1938.

Mr. W. Thurgood, President of the Yorkshire Conchological Society, in the chair.

Present: Drs. H. C. Versey and J. W. Jackson, Messrs. J. C. North, Don Fisher, J. Digby Firth, B. Bussey, A. K. Lawson, C. H. Moore, Fred Taylor, E. Dearing, H. J. Armstrong, and Mrs. Morehouse.

Election of New Members.

Dr. Henry van der Schalie; F. H. Ludham; Alexander Comfort; Mrs. Gladys I. Fowler.

Papers Read.

"*Zoogenetes harpa* (Say) in Switzerland," by C. Oldham.
"A Surrey Bronze Age Interment," by A. E. Ellis.

Exhibits.

By Mr. C. Oldham: Specimens to illustrate his paper.

By Mr. C. H. Moore: Selection from the J. Brazier collection, with original notes: also non-marine and marine shells collected at Barmouth

and neighbouring places in September. Notes on the changes due to altered conditions during the last twenty years were read.

By Mr. W. Thurgood: *Ancylastrum fluviatile* (Müller) var. *albida* Jeff., from Malham Cove, Yorks, 26–6–1938, *Acicula lineata* (Drap.), from Forge Valley, Scarborough, 7–7–1938, *Hydrobia jenkinsi* (Smith), from ditch, Moortown Ring Road, junction with King Lane, Leeds, 20–5–1938, also *Pisidium milium* (Auct.), *P. nitidum* (Jen.), *P. subtruncatum* Malm, and *Succinea pfeifferi* Rm. all from Shirley Pool, Askern, Doncaster, 25–6–1938.

By Mr. H. J. Armstrong: Native shell-currencies from New Guinea, and other places.

By Mr. G. C. Spence: Shell-necklace from Solomon Is., used as currency; also series of operculates showing curious methods of closing the aperture: these included *Rhiostoma*, *Pupina*, *Pupinella*.

By Mrs. Morehouse: Counters of pearl-shell from China—some nicely carved: also a group of smaller land-shells from the West of Ireland.

By Mr. A. K. Lawson: Discoloured pearls from the River Tay, at Perth.

By Mr. Fred Taylor: A large series of beautifully mounted shells from Miller's Dale, Derbyshire, and Irish localities; darts from different Helices; aliens from the lily-tanks at Kew Gardens, London; also *Vertigo lilljeborgi* from the Lake District.

By Dr. J. W. Jackson: Shells of *Margaritifera margaritifera* (adult and young) from the River Blackwater, Co. Kerry, Eire (coll. J. Abernethy).

656th Meeting, held at the Manchester Museum, 10th December, 1938.

Mr. G. C. Spence in the chair.

Candidate Proposed for Membership.

Mr. L. C. Lloyd, The Groves, Wenlock Road, Shrewsbury (introduced by C. Oldham and J. W. Jackson).

Members Resigned.

N. G. Hadden; Dr. Hermitte.

Paper Read.

"Note on *Littorina saxatilis nigrolineata* Gray," by Mrs. McMillan.

Exhibits.

By Mrs. McMillan: Specimens to illustrate her note; also varieties of *Littorina littorea*.

By Mr. G. C. Spence: Various species of *Achatina*.

By Mr. C. H. Moore: Sundry specimens from the J. W. Taylor collection.

The Special Exhibit was *Vallonia* and many series were shown.

657th Meeting, held at the Manchester Museum, 7th January, 1939.

Mr. G. C. Spence in the chair.

Additions to the Library were announced by the Librarian.

Election of New Member.

L. C. Lloyd.

Member Deceased.

Rev. W. A. Shaw.

Exhibits.

By Mr. G. C. Spence: *Hybocystis* and *Pupinella*.

The Special Exhibit was *Hygromia* and many series were shown by Messrs. C. H. Moore, F. Taylor, G. C. Spence, along with others from the J. Kidson Taylor, J. E. Cooper, and C. Oldham collections.

658th Meeting, held at the Manchester Museum, 11th February, 1939.

Mr. G. C. Spence in the chair.

The Librarian reported a number of additions to the Library and the usual periodicals received in exchange.

Members Deceased.

Professor J. W. Carr. Mrs. Gill.

Members Resigned.

Mrs. Ida S. Oldroyd. The Brighton Public Library.

Papers Read.

" A New Species of *Rhiostoma* from Malaya," by Dr. F. F. Laidlaw.
" The Genus *Plesiophysa* P. Fischer," by J. Bequaert and W. J. Clench.
" Further Notes on *Limapontia depressa* (A. & H.), var. *pellucida* Kevan," by D. K. Kevan.
" A New South African *Vermetid*," by J. R. le B. Tomlin.
" New Malay Land-Shells," by J. R. le B. Tomlin.
" Note on *Urocoptis* (*Autocoptis*) *olssoni* Pils.," by G. C. Spence.
" How do Land Operculates reproduce ? " by G. C. Spence.

Exhibits.

By Mr. G. C. Spence : Specimens to illustrate his paper on *Urocoptis*.
By Mr. C. H. Moore : Specimens from the Society's Voucher Collections.
By Mrs. Morehouse : *Siliquaria australis* and *Vermetus* sp.

659th Meeting, held at the Manchester Museum, 11th March, 1939.

Mr. G. C. Spence in the chair.

The Librarian announced a number of additions to the Library.

Candidates Proposed for Membership.

Dr. Fritz Haas, Field Museum of Natural History, Roosevelt Road, Lake Michigan, Chicago, U.S.A. (introduced by H. C. Fulton and J. W. Jackson).

John Erskine Kempe, Rhianva, Menai Bridge, Anglesey (introduced by J. W. Jackson and G. C. Spence).

Clement Evans, Neuholme, Willington, Derby (introduced by J. W. Jackson and G. C. Spence).

Paper Read.

" *Cypræidæ* from Atafu Island, Union Group," by William Marcus Ingram.

Exhibits.

By Mr. C. H. Moore : Various species of *Planaxis* and *Amphibola*.
By Mr. G. C. Spence : African species of *Potadoma*.
By Mr. W. Thurgood : A live specimen of *Orthalicus zebra* imported with bananas from Jamaica.

The Special Exhibit was " British Xerophiles " and many series were shown by Messrs. C. H. Moore, and F. Taylor, also by Mrs. Morehouse. Series from the Society's Cabinet were also exhibited.

660th Meeting (Joint Meeting with the Yorkshire Conchological Society), held at the Manchester Museum, 1st April, 1939.

The President, Captain Cyril Diver, in the chair.

Present : Messrs. C. H. Moore, A. K. Lawson, F. Taylor, J. H. Lumb,

G. C. Spence, B. Bryan, H. Emmett, Dr. J. W. Jackson, Mr. and Mrs. A. Thurgood, Mrs. McMillan, and Mrs. Morehouse.

Apologies for absence from Messrs. J. C. North, E. Dearing, and Don Fisher.

Election of Members.

John E. Kempe, Dr. Fritz Haas, Clement Evans.

Address by the President.

Captain Diver gave a most interesting talk on the *peregra-involuta-burnetti*-group of *Lymnæa*. This gave rise to much discussion on species, sub-species, and varieties.

Exhibits.

By Captain C. Diver: Specimens to illustrate his talk.
By Mr. B. Bryan: *Milax sowerbyi*, *M. gagates* and *M. gracilis*, from Stoke-on-Trent.
By Mr. H. Emmett: *Ancylus fluviatilis* var. *alba* from Dovedale; *Helix nemoralis* (darts) from Basford; and *H. lapicida* from Ricklow Dale.
By Mr. C. H. Moore: Species of *Nassarius*.
By Mrs. Morehouse: Species of *Phasianella*.
By Mr. G. C. Spence: Species of *Eucalodium* and *Coelocentrum*.
By Mr. J. H. Lumb: Species of *Helicina* and *Cyclostoma* from Jamaica.
By Mr. F. Taylor: *Geomalacus maculosus* from Glengariff, Co. Cork; and *Melantho decisa*, dextral and sinistral, from Ontario.

HOW DO LAND OPERCULATES REPRODUCE?

(*Read before the Society*, 11*th February*, 1939.)

Do they lay eggs or are they viviparous? For a long time I have been trying to obtain an answer to the question but so far without success. The only reference I have found is a note by Dupuis and Putzeys which, referring to *Cyclophorus intermedius Mts.*, says, "les œufs sont noirs, petits et très nombreux." [1] When extracting the body of a *Rhiostoma* from its shell the presence of a large number of small black spheres appeared to confirm the statement, but microscopical examination of these "eggs" revealed that they were in reality excreta. Thinking it possible that Dupuis and Putzeys had made the same mistake as myself I wrote Dr. Dartevelle of Tervueren Museum where Dupuis's collection is housed. He has very kindly gone into the matter and writes me that the "eggs" referred to have not been preserved in the collection nor is he able to find any trace of eggs in the specimens of the group at Tervueren. The late Robert Standen made a special study of molluscan eggs but, so he informed me, had never been able to find out anything with regard to the Operculates. Finally, J. W. Taylor in MS. notes on *Cyclostoma elegans*, which I have been privileged to see, remarks that the method of reproduction does not appear to have been observed.

These notes have been written in the hope that light may be shed on the matter from some quarter or another.

G. C. Spence.

[1] *Ann. Soc. roy. Mal. de Belgique*, xxxvi, p. xlii.

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THE MASON COLLECTION OF BRITISH SHELLS.

By R. Winckworth.

(*Read before the Society, 2nd February, 1940.*)

The recent acquisition by the Liverpool Free Public Museums of the Winckworth collection of British marine mollusca makes it desirable to put on record some account of the Mason collection, which forms well over half of its bulk.

Philip Brookes Mason was an enthusiastic naturalist, interested in both zoology and botany, but specially in birds, shells, and insects; he himself collected in many parts of the British Isles, from Shetland to Cornwall and the Channel Islands and from Galway to East Anglia. A brief obituary will be found in this journal.[1] He published but little; apart from the address [2] delivered by him as President of this Society, there is only a note [3] on *Bulimus detritus*. On his death in 1903 his various collections passed to his widow and were in due course disposed of. The shells were purchased by L. StG. Byne in 1914 and ten years later I eagerly accepted the opportunity of buying them from him.

Fortunately Mason kept a catalogue, which enables one to see what an excellent collector he was himself; it also shows that he spared no pains to make his collection as fully representative as possible by exchange and purchase. The two principal sources of his wealth of specimens were the Leckenby collection and the Walpole collection. Both were acquired through R. F. Damon, of Weymouth, a naturalist dealer of high repute and great reliability, who was a member of the Malacological Society until 1904. Mason appears to have bought the greater part of the Leckenby collection, which Damon acquired in 1879.[4]

John Leckenby, of Scarborough, who is frequently mentioned by Gwyn Jeffreys, specialized in the shells of Yorkshire and of the North Sea [5]; he also tried to get the largest and finest specimens obtainable of every British species and examples of aberrant and monstrous individuals, among which the series of *Neptunea* is of great interest and variety; one may also mention the *Buccinum undatum*, $6\frac{1}{2}$ inches long,[6] and one of the four known sinistral *Littorina littorea*.[7] Leckenby obtained much material from W. Rich,

[1] Thornewill, *J. Conchol.*, vol. 10, p. 104 (1904).
[2] Mason, *J. Conchol.*, vol. 7, p. 328 (1894).
[3] Mason, *J. Conchol.*, vol. 3, p. 118 (1880).
[4] Roebuck, *J. Conchol.*, vol. 2, p. 290 (1879).
[5] See Leckenby and Marshall, *Ann. Mag. N.H.* (4), vol. 16, p. 390 (1875).
[6] Jeffreys, *British Conchology*, vol. 4, p. 287 (1867).
[7] Jeffreys, *British Conchology*, vol. 3, p. 370 (1865); Marshall, *J. Conchol.*, vol. 9, p. 123 (1898).

of Russell Street, London, who was described by Jeffreys [8] as "an intelligent collector and dealer", though his localities were often unreliable. Leckenby was also interested in the geology of Yorkshire.

The collection of W. W. Walpole was sold in 1867 by his executors, who prepared a "Catalogue of Collection of British Shells made by the late William White Walpole, containing over 6,000 specimens. All in excellent condition and comprising almost all the species and varieties mentioned in Jeffrey's British Conchology". Walpole also had a large collection of Unionidae. The British collection was purchased by Damon, from whom Mason bought it. Walpole published a few papers on Irish mollusca and two catalogues of the mollusca of Dublin.[9]

These two collections in their turn comprise much material from contemporaries and from earlier conchologists. Specially interesting is a long series of Exmouth shells from W. Clark, the author of *British Testaceous Mollusca*, including the type of *Cerithiopsis clarkii* F. & H.[10] Clark also had specimens from Professor W. King of his varieties *crassus*, *littoralis*, and *magnus* [11] of *Buccinum undatum* from Northumberland. Another interesting item in the Clark collection has a label in Clark's handwriting: "Crenella faba | from a wild duck's stomach | Mr. King N-Castle. Shot in Nthberld. 1849." There are also syntypes of *Modiola cuprea* Jeffreys [12] from W. Bean, of Scarborough, with Clark's label.

The Mason collection contains many specimens from J. G. Jeffreys, which are of special value, since the Jeffreys collection went to America. These came through the Walpole and Leckenby collections; many of them reached Walpole via A. Bell, who, like his brother R. Bell, was a professional collector of shells and fossils. Alfred Bell lived to be over 90 and as late as 1920 wrote a revision of *British oysters, past and present.*[13] In addition to A. and R. Bell, there also appears among the Walpole sources G. Bell, an early London collector of about 1830. The Walpole collection naturally included several Irish contributors, Dr. R. Ball, Dr. Farran, J. D. Humphreys of Cork, Mrs. Puxley, S. A. Stewart, an artisan naturalist of Belfast, E. Waller, who explored the Turbot bank off the Antrim coast, and T. W. Warren, whose collection went to the Royal Dublin Society. Other names, equally familiar to

[8] *British Conchology*, vol. 1, p. xliv (1862).

[9] *Ann. Mag. N.H.* (2), vol. 10, pp. 77, 237, 310 (1852), and vol. 12, pp. 366, 367 (1853); *Zoologist*, vol. 11, pp. 4022, 4101 (1853).

[10] Forbes & Hanley, *Hist. British Mollusca*, vol. 3, p. 368 (1851).

[11] *Ann. Mag. N.H.*, vol. 18, p. 248 (1846), and vol. 19, p. 336 (1847).

[12] *British Conchology*, vol. 2, p. 136 (1863). For *Crenella faba* see the preceding p. 135.

[13] *Essex Naturalist*, vol. 19, p. 183 (1920), and p. 300 (1921).

readers of Jeffreys' *British Conchology*, which appear in the Mason catalogue are: G. Barlee, whose collection is now in the Oxford University Museum; W. Bean; Captain Bedford; Dr. P. P. Carpenter; Rev. R. N. Dennis, of Jersey; B. Sturges Dodd, of Nottingham; W. Hockin (and Miss S. Hockin), of Hayle, Cornwall; H. K. Jordan, F.G.S., of Newport, Mon.; W. Lyons, of Tenby; R. MacAndrew, F.R.S.; Canon A. M. Norman, F.R.S.; W. Turton.[14]

Altogether seventy-one different sources are given in the catalogue, of which the following should also be mentioned: H. E. Bridgman, of Norwich (many species from Torcross); Calvert, the dealer, who created a scandal by eloping with G. B. Sowerby's sister; J. T. Carrington, editor of *Science Gossip*; E. Charlesworth (Crag shells), fossil dealer and editor of the *Magazine of Natural History*; Mrs. Fitzgerald, of Folkestone, and her sister, Miss F. M. Hele, whose collection was advertised for sale on the covers of this journal in 1892; C. Jefferys, a dealer, on occasion unreliable in locality as when he sold Mediterranean material as British; G. H. King, an early dealer; J. T. Marshall, who wrote *Additions to British Conchology*; T. A. Verkruzen, traveller, collector, and London dealer; and R. Woodcock, of Jersey.

The land and freshwater shells of the Mason collection I gave to A. S. Kennard in 1924, as I was only working on marine material. They come largely from Walpole and Leckenby and from Mason's own collecting. Mason also bought the collection of Rev. Revett Sheppard, F.L.S.,[15] including the types of *Tellina henslowana* (a *Pisidium*) and *Turbo leachii* (a *Bithynia*). Another source was the collection of J. Pickering, wharfinger; this included the types of *Rissoa castanea* Sowerby,[16] now in the British Museum.

While in Byne's keeping many more specimens were added; he specially tried to make the collection of *Patella* representative.

Finally I amalgamated the Mason collection with my own, formed by shore collecting and dredging in many parts of the British Isles from 1910 onward, and assisted by many valuable gifts from J. R. le B. Tomlin, P. Dautzenberg, W. Fowler, and others. A list of species added to the original Mason collection is perhaps of interest, viz. *Potamopyrgus jenkinsi* (Smith), *Tornus*

[14] Information about P. P. Carpenter and W. Lyons will be found in this journal, vol. 6, p. 218 (1890); see also vol. 20, pp. 230, 237, 239, 241 (1936), for notes on Lyons, Bean, MacAndrew, and Carpenter, and vol. 16, p. 40 (1919), for an obituary of A. M. Norman.

[15] Of Wrabness, Essex; earlier of Nacton and of Offton, Suffolk; F.L.S. 1805–1830. A list of Suffolk shells by him was published in *Trans. Linn. Soc.*, vol. 14, p. 148 (1823).

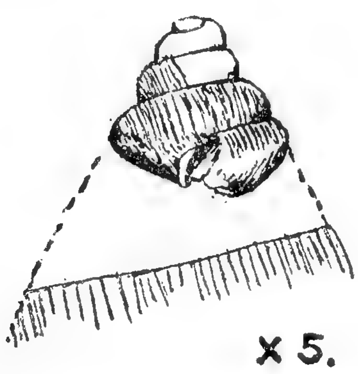
[16] See *British Conchology*, vol. 1, p. 69 (1862). The specimens seem to me rightly assigned to *Hydrobia ventrosa* (Montagu).

imperspicuus (Chaster), *Balcis* spp. from E. R. Sykes, *Odostomia perezi* D. & F. and *Montacuta phascolionis* D. & F. from Roscoff through Professor Perez, *Crepidula fornicata* (L.), *Galeodea rugosa* (L.), *Urosalpinx cinerea* (Say), *Spiratella lesueurii* (Orb.), *Onchidella celtica* (F. & H.), *Ostrea virginica* Gm. and *O. angulata* (Lam.), *Modiolus gallicus* (Dautz.), *Devonia perrieri* (Malard), *Petricola pholadiformis* Lam. and *Xylophaga praestans* Smith.

NOTE ON *UROCOPTIS* (*AUTOCOPTIS*) *OLSSONI*, PILS.

(*Read before the Society, 11th February, 1939.*)

In his monograph Dr. Pilsbry remarks that the nepionic sculpture of the sub-genus Autocoptis is unknown. Again when describing the above species he states that " the shape of the upper discarded part of the spire is unknown ".[1] The following description of the tip of a specimen from the type locality, El Morro, near Monte Cristi, Santo Domingo, may therefore not be out of place.



x 5.

The embryonic shell consists of $2\frac{1}{2}$ whorls, intorted at the dome-like summit, having a frosted glass appearance but no discernible sculpture. The following whorls are finely striate and distinctly marked off from the embryonic portion. The annexed sketch will give a better idea than mere description.

G. C. Spence.

CORRECTION.

In my account of the Land and Freshwater Mollusca of the Cavehill appearing on p. 167 of the current volume of the Journal, for *C. acicula* (Müller) read *Acicula lineata* (Drap.).

Ranald MacDonald.

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[1] *Proc. Acad. Philadelphia,* vol. lxxxv, 148–9.

SOME DEVON LAND SNAILS.

By A. E. Ellis.

(*Read before the Society, 2nd February, 1940.*)

Hygromia odeca Locard: There is a colony of this species at Maidencombe, 3 miles from Combe-in-Teignhead, where it was discovered by Mr. A. S. Kennard in 1917.[1] The habitat is amongst grass, chiefly *Festuca* and *Dactylis*, and at the roots of burdock, at the foot of the cliffs, extending down to the extreme limit of vegetation. In fact, one or two of the snails were on rocks below the grass verge. The associated species of Mollusca are: *Lauria cylindracea* (da Costa), *Ena obscura* (Müll.), *Arion hortensis* Fér., *A. ater* (L.), *Clausilia rugosa* Drap., *Candidula caperata* (Montagu), *Trochulus hispidus* (L.), *Goniodiscus rotundatus* (Müll.), *Cepaea hortensis* (Müll.), *C. nemoralis* (L.), *Helix asper a* Müll., *Retinella pura* var. *nitidosa* Gray, *R. nitidula* (Drap.), *Oxychilus lucidum* (Drap.), *Vitrina pellucida* (Müll.), and *Pomatias elegans* (Müll.). The prevalent form of *H. odeca* at Maidencombe, as at Combe-in-Teignhead, is var. *sarratina* Moq., with a deep reddish fawn shell, but var. *brunnea* Gassies and var. *typica* Germain are also represented. The diameter of the shells ranges from 11 to 13 mm. Nearly all the specimens found were fully grown (28th April, 1939).

Vitrina major Férussac: This species occurs in Stoke Woods, between Exeter and Stoke Canon, amongst *Luzula sylvatica*, ivy and dead leaves, and under fallen branches. The following species were also noted: *Clausilia rugosa* Drap., *Goniodiscus rotundatus* (Müll.), *Arion circumscriptus* Johnston, *A. hortensis* Fér., *A. ater* (L.), *A. intermedius* (Normand), *A. subfuscus* (Drap.), *Cepaea hortensis* (Müll.), *C. nemoralis* (L.), *Zonitoides excavatus* (Alder), *Retinella pura* (Alder), *R. nitidula* (Drap.), *Oxychilus alliarium* (Miller), *O. rogersi* (B. B. Woodward), *O. cellarium* (Müll.), *Agriolimax agrestis* (L.), *Limax cinereo-niger* Wolf, *L. maximus* L., and *L. marginatus* Müll. The predominance of slugs and *Zonitidae* is a notable feature of the molluscan fauna of these woods. The record by E. D. Marquand, 1890, of *V. pellucida* var. *depressiuscula* Jeff. from Stoke Woods is probably referable to *V. major*.

[1] *Proc. Malac. Soc.*, xiii, 1918, p.14.

IDENTITY OF COLUMBELLA FISCHERI HERVIER AND C. PERPLEXA SCHEPMAN.

By W. S. S. van Benthem Jutting.
(Zoological Museum, Amsterdam.)

(*Read before the Society, 2nd February, 1940.*)

When studying minute shells from coral shingle of various islands in the Bay of Batavia (Java), collected by members of the staff of the Laboratory for Marine Investigations at Batavia, I came upon several lots identical with what was called *Columbella fischeri* by J. Hervier (*Journ. de Conch.*, vol. 47, 1899, p. 389, pl. 14, f. 8), collected at Lifu.

Several years later M. M. Schepman described what was evidently the same species as *Columbella perplexa* (*Siboga Exped.*, Livr., xlix–1–d, 1911, p. 337, pl. 20, f. 12) from north of Salomakiëe Island (close to the southern tip of the Island of Halmaheira, Moluccas). The only difference seems to be an ornamentation of sparse, irregular white spots, occurring in *perplexa*, not mentioned for *fischeri*.

It is interesting to see from their discussions that both authors experienced almost exactly the same difficulties in classifying this little species. Both mention its affinities to *C. dormitor* and to *C. atramentosus*. Therefore the conclusion seems not too hazardous that the paper by Hervier must have escaped Schepman's notice.

Later investigations removed a few closely related Columbellids to the genus *Mitromorpha* A. Adams, and recently Iredale (*Proc. Mal. Soc.*, vol. 12, 1917, p. 329) proposed a new genus, *Lovellona*, for the species *atramentosus* Reeve, *parvus* Pease, and *micarius* Hedley. In my opinion *C. fischeri* has to join these and has to be called in future *Lovellona fischeri* (Hervier), syn. *perplexa* (Schepman).

The specimens from the coral shingle in the Bay of Batavia were found on the following islands : Alkmaar, Dapoer, Enkhuizen, Hoorn, Kerkhof, Leiden, Middelburg, and Rotterdam. With these localities the dispersal of the species underwent a notable increase to the west. The majority of my shells indeed bear the scattered white spots on the whorls, but there are a few which are devoid of them, thus demonstrating that the presence of this ornamentation is not an absolute necessity and not a final characteristic.

APPARENT DISAPPEARANCE OF LIMNAEA PEREGRA FROM FRISTON POND, EASTBOURNE DOWNS.

By G. Shrubsole.

The notes in this Journal, vol. xx, p. 217, were written in October, 1935; since then the pond has been visited again and the results appear to confirm my deductions.

On 26th May, 1936, J. R. le B. Tomlin and I carefully dredged all round the pond. *L. stagnalis* was taken in large numbers, both adult and young, and could be seen all over the pond. Only one dead half-grown specimen of *L. peregra* came to hand, though this species was carefully sought for.

On 20th July, 1936, the pond was again dredged all round. Many hundreds of *L. stagnalis* were seen and dredged, from three-quarters of the adult size (for the pond) to fry. The biggest snails appeared to have died off. Not a single specimen of *L. peregra* was taken.

The pond was dredged again 24th August, 1939, after an interval of three years. *L. stagnalis* could be seen and many were dredged, but by this time of the year many of the adult snails were dead and their shells were found. Not a single specimen of *L. peregra* could be found. Six to eight *P. albus* and two *S. lacustre* were taken.

L. peregra may or may not be totally extinct in this pond but up to about 1932 it was full of them, now an hour's dredging fails to secure a single specimen. *H. jenkinsi* is more numerous than ever, if that is possible.

Another pond (cemented) on the Downs at Ratton contained (1934–36) nothing but *L. stagnalis* in large numbers. As the earlier history of this pond is not known, it is impossible to say if *L. peregra* has disappeared from it. It appears likely as *L. peregra* is the commonest species in these Downs ponds and in the marshes round them.

MARINE SHELLS OF MADRAS.

By M. D. Crichton.

(*Read before the Society, 2nd February, 1940.*)

Melvill and Standen [1] computed the total of Madras marine mollusca at slightly over 700 of which, approximately, 470 were univalves and 230 bivalves. It should be noted, however, that the collections examined by them when compiling their catalogue included specimens from the neighbourhood of Pamban, a distance of 235 miles by sea from Madras, where coral formation predominates in marked contrast to the unrelieved sand of the southern portion of the East Coast of India. As there are many mollusca peculiar to coral-reef conditions which are not found elsewhere there would appear to be reason—if only as a matter of local interest—for keeping separate a record of species which are known to make their homes, in some cases it may be only as temporary visitors, within sound of the surf of the Coromandel Coast.

I have had opportunities of collecting at many places along the shores of this coast besides dredging down to 6 or 8 fathoms off Pondicherry, Cuddalore, Porto Novo, and Negapatam, and to a greater depth at Madras, and am satisfied that the forms found at Madras may be regarded as typical of the entire coast, say from Point Calimere (Lat. 10° 18′ N.) to Cocanada (Lat. 17° N.). The territory covered by these notes, however, will be confined to the strip of sea-board in the immediate vicinity of Madras, extending about thirty miles from Ennur towards Covelong in the south. Apart from the harbour area the coast presents an unbroken vista of yellow sand except where intersected by the channels of the backwater at Ennur and of the Cooum and Adyar, two small rivers whose egress is barred periodically by great banks of sand piled up during the dry months following each north-east monsoon.

Consequently the mollusca comprise chiefly the dwellers in sand and mud, the only rock habitations being those provided by the hand of man, such as the blocks of concrete and stone placed as breakwaters for the protection of the harbour walls and the revetment immediately north of Royapuram Bay. The total number of species known to Madras is upwards of 600, approximately 400 univalves and 200 bivalves. This total is constantly being added to. The mollusca here enumerated should be taken merely as a general indication of some of the species to be found.

[1] The marine mollusca of Madras and the immediate neighbourhood *J. Conchol.*, vol. 9, pp. 30–85 (1898).

The Littoral Zone.

The number of living mollusca within reach of the seeker along the shore is limited, not only by the absence of such favourite molluscan haunts as reefs and rock-fringed pools but also by the restricted collecting area available between high and low water mark, the average rise and fall of the tide being under 3 feet with a maximum of 4·2 feet. Even so, a diligent search within wading depth will bring to light a fair range of species varying regularly in seasonal rotation throughout the year. The most noticeable of these visitors is the lively tapering *Bullia vittata* (L.) with large water-charged foot and narrow and inadequate operculum which, with the rarer *B. livida* Reeve, may be seen in considerable numbers on the firm wet sand at low tide, particularly at Parry's Beach to the south of the harbour. This, on occasion, feeds on the little round-backed crab (*Philyra*) whose arrival synchronizes with that of *Bullia ;* after an initial " hand off ", the crab submits to being seized without any further effort at resistance and is soon drawn within the muscular folds of the mantle. So determined is the hold on its victim that the *Bullia* can be pulled almost completely out of the shell without losing its grip. This mollusc dwells with us for several months each year, during which time its family increases and grows up rapidly. The shell of *B. livida*, although resembling that of *B. vittata* both in shape and design, except that the spiral band of tubercles below the sutures of the latter consists of two or three rows whereas in *B. livida* it is usually single, will be easily recognized by a richer colouring and thickened outer lip, in addition to which the operculum is squarely oval and more or less fills the aperture. *B. tranquebarica* (Röding) is a third local representative of this genus of the family *Nassariidae*, and its triangulate operculum with serrated edge completes the three types of operculum associated with this family.

Farther south, at St. Thomé and beyond, olive-shells are to be found at all seasons, both *Oliva oliva* (L.) and *O. ispidula* (L.), the latter in an infinite variety of colours and markings. Early in February each year large colonies of *Oliva gibbosa* (Born), in mature form, are to be found for a brief season near the shore at Elliot's Beach, the raised ridges of their mole-like burrows in the sand indicating their position. This handsome shell attains a length of some 3 inches and bears a close resemblance to *O. nebulosa* Lam., both in pattern and colouring. The latter, however, is narrower with a more tapering spire. Unlike *O. gibbosa* it is very rarely taken near the shore although commonly dredged in from 6 to 10 fathoms.

The Olives are also carnivorous and show a partiality for the

shy little mole-crab (*Hippa asiatica* Edwards). I have more than once witnessed the unequal contest with the victim struggling valiantly but helpless in the pincers-like grip of *O. ispidula*, whilst the swift incoming waves have swept the pair several times up and along and down the gently sloping beach and finally into deeper water without being able to break them apart.

Rapana bulbosa (Dillwyn) is sometimes swept shorewards during stormy weather and may be found clinging to an old shell or root of sea-weed, the young ones adhering to each other in clusters. *Nassarius* and *Natica* may also be taken.

Amongst the bivalves which feed near the shore are found four or five kinds of wedge-shell, the finest being the magnificent *Donax scortum* L., strongly fashioned with deep corrugations and rich purple interior. The commonest is *D. cuneatus* L. in a range of colouring, radiating from the umboes, which includes pale blue, yellow, brown, and a harsh liver-green. The young are in evidence in October in the shelter of Ennur backwater, while in February and March the half-grown and adult shells may be found together in large numbers between tide marks at St. Thomé and Ennur. In calm water the circular orifice of the upper or lower siphon may be observed just above the surface of the sand, indicating the presence of the shell buried an inch or so below. Fully grown shells measure from 40 to 43 mm. in length. Other all-the-year-round frequenters of the intertidal region include *Sunetta scripta* (L.), beautifully and variously patterned in purples, browns, mauves, gold, and ivory. These make their début about December and their growth may be followed month after month until the following autumn when they attain a full stature of some 33 mm. Several other brightly patterned species of the Venus family are also found.

Mactra cygnus Gm., whose thin but strongly formed shells, in a good range of colours, are usually to be found scattered on the beach, visits the shallows for a brief period only during the south-west monsoon, the young shells beginning to appear about April. *Mactra mera* Rv., *M. striatula* L., and young *M. turgida* Gm. are not uncommon towards the end of the north-east monsoon. The shells are seldom found complete, unless taken alive.

Of the Garidae, *Soletellina diphos* (L.) should be looked for immediately south of the Adyar during the first violent storms of the north-east monsoon when it is dislodged from its sandy bed and flung ashore. Unless freshly collected the valves soon become separated, the thick greenish yellow periostracum cracks and peels away and the hot sun quickly bleaches the rich purple colouring of the shell. The young may be found earlier in the year in the

extensive backwaters at Ennur and Covelong which are periodically open to the inflow of the sea.

The fan-oyster (*Pinna*) is another dweller in or near the channel of the Adyar river to seaward; live specimens are sometimes uprooted from their burrows during the north-east gales. *Pinna* grows to a large size, *P. pectinata* L. (=*hanleyi* Rv.) and *P. attenuata* Rv. having both been found at Madras up to over one foot in length. A specimen of the latter, taken at Tuticorin, measures 19½ inches. A third species, *P. vexillum* Born, of dark colour and spreading shape and provided with a short, strong byssus, is occasionally delivered up during stormy weather a few miles farther south; mature shells of this species are of heavy, stout structure and are easily recognized. It may be noted that the byssus, usually associated with *Pinna*, was not present in any of the three living specimens of *P. pectinata* secured by me. It seems possible that these particular individuals, living in sand, without stones or other suitable anchorage available, had no use for a byssus. *Pinna* breeds about May or June to judge by a 20 mm. juvenile collected towards the end of June. *Siliqua radiata*, the sunset-shell, is very seldom taken alive or even with periostracum, but the spread-out empty valves, brilliantly rayed with blue and white, are abundant on the wet sands at ebb-tide.

Shore Collecting

High-water mark throughout the year will reward the diligent seeker with a varying and fascinating harvest, chiefly of the smaller sort. There are many sharp little eyes at our service among the children of certain villages by the sea who have learnt to know what the *changu-dorai* wants and what he does not want. From these high-tide gatherings could be named upwards of one hundred species, but a selection must suffice.

The gastropod Aglossates are well represented. Of these the brilliant *Pyramidella terebellum* (Müller), with deep-chestnut spiral bands, grows to a full inch. The genus *Turbonilla*, of the same family, is represented by five or six species, including the white *T. coromandelica* (Melv. & St.), growing to 21 mm. With the aid of a magnifying glass may be clearly seen the peculiar development of the shell, the spiral growth of which begins in a sinistral direction thereafter twisting at right angles and finally developing in a normal dextral manner. The allied family of Eulimidae is represented by polished shells of the genera *Eulima*, *Balcis*, and *Niso*. The last is represented by two species, one of which, *Niso pyramidelloides* Nevill, just over half an inch in height and recognizable by its double spiral band of rich chestnut-brown,

is among Madras's loveliest shells. *Balcis* is of snow-white colour, a typical feature of many species being a graceful backward bend which is very noticeable in *B. martinii* (A. Ad.). *Eulima* is usually spirally banded with brown; the local species *S. bivittata* (H. & A. Ad.) grows to about $\frac{3}{4}$ in. in height. Some Eulimids are parasitic on "sea-cucumbers" to which they attach themselves so firmly that considerable force is required to dislodge them. These shells are washed up during the south-west currents between March and August each year.

Another attractive genus is the familiar wentletrap or *Epitonium*, of which some half-dozen species may be gathered during the same season; also two species of the little *Ringicula*, and the iridescent *Minolia impressa* (Nevill). These last three, and other small fry such as *Bullina*, *Pupa*, *Cylichna*, should be sought for amongst the scum and weeds of high-water mark on the seaward bend of the estuary at Ennur.

The Scaphopoda are represented at Madras by one species of *Cadulus* and by five or six of the well-known *Dentalium* or elephant's tusk-shell. Beach specimens of the latter are usually broken and should not be collected unless the posterior or smaller end is intact, the margin of the small opening being often notched on the convex side. In addition, several species are furnished with a small supplemental tube protruding from the apical end, easily broken. Besides the smooth forms, *D. octangulatum* Don. may be found with seven, eight, and nine main ribs.

The Class Cephalopoda comprises creatures of the type of squid, octopus, etc., in which the shell is internal or absent. The calcareous "cuttlefish bones" which litter our beaches at all times belong to *Sepia* and *Sepiella*. *Sepia prashadi* whose pink-backed shells, up to 110 mm. in length, are to be found from January to early in April each year, has only recently been described. A small *Doratosepion* also occurs, measuring 2 inches, of similar colouring towards the spine but narrower in shape and with the dorsal longitudinal depressions undeveloped; rare here, it is common on Khor Maksar beach at Aden. *Loligo* is very common; a live individual must be secured in order to obtain a specimen of its transparent and perishable "pen".

The shells of the three external shell-bearing Cephalopods are also to be found at Madras. Those of the deep-sea *Spirula spirula* (L.) and of *Nautilus pompilius* L. are thrown up in stormy weather, the latter always in fragmentary condition. I once picked up a young Nautilus shell measuring 1 inch in length about eight miles south of Elliot's Beach and I have also found one *Argonauta hians* Sol. in what appears to be fresh condition. This indication of the

presence of a Nautilid nursery off the Coromandel Coast must not be accepted too readily as these shells are very buoyant and may be brought to our shores from other parts by monsoonal currents.

The arrival of large numbers of the seed pods of *Carapa obovata*, also stated to be *C. moluccensis*, during the early months of each year when north-easterly winds have already been blowing for two or three months, may be cited as an instance of the carrying power of the winds and sea currents. The Carapa tree grows in the tidal forests and mangrove swamps of Malaya, on the Aracan Coast of Upper Burma and, doubtless, in the Nicobars and Andamans and it seems likely that some of the pods which reach Madras may have come from the last-named place which is a known habitat of *Nautilus*. The nearest location of Carapa to Madras is fully 200 miles to the north, in the Guntur forest division, so that in any case the pods in question must have travelled by sea for a considerable distance.

The Carapa pods should be examined as they frequently harbour a nest of ship-worms (*Teredo*) which, as free-swimming fry, have attached themselves to the floating homes so conveniently offered and dug themselves in to such good purpose that during the long sea voyage they have developed and grown to full capacity, supplanting the kernel and filling the entire shell with a closely packed twist of their strange tubular casings. Inside these tubes will be found the palettes and shells of *Teredo clava* Gm. Similarly, waterlogged branches or pieces of timber often house *Martesia* and should not be passed by unchallenged.

Amongst the less common lamellibranchs should be recorded the watering-pot shell (*Brechites*), with aberrant valves which fail to function in a normal manner at an early age, and become embedded in a cylindrical tube, 4 or 5 inches long, terminating at the lower extremity in a perforated convex shield surrounded by a frilled border of tubes branching out like the petals of a flower, the perforated centre being reminiscent of the rose of a watering-pot. An examination of the tube, immediately above the rose, will locate the useless bivalve shell *in situ*. *Cucurbitula cymbium* (Spengler) is another lamellibranch whose shell is even more effectively disguised. *Cucurbitula* creates for its burrow a pear-shaped encasement, moulded of sand and shelly matter, generally attached to another shell or piece of loose coral.

The months of May to August, when southerly winds prevail, provide us with an interesting series of juveniles in the earlier stages of shell development, i.e. at the commencement of the enlargement of their homes from the embryo or veliger stage.

A powerful magnifying glass is essential in order to be able to note and appreciate the delicate beauty of these embryonic shells.

During the periods of storm, particularly in the autumn, Aviculids (Pteriidae) may be found still clinging to the branches of sea-fans which have been torn from the ocean bed, the shells varying in tone between yellow and red according to the colour of the particular Gorgoniid adopted for their life-long dwelling place. At these times some of the larger worn and broken shells which are washed ashore, such as *Ficus*, *Turritella*, etc., usually contain a family of the flat slipper limpet, *Crepidula walshii* Herrm., as many as a dozen often being crowded together into a wholly inadequate space, the neat circular baby shells clinging to the backs of their elders. The apices of the young shells show clearly the original spiral formation. It is advisable to boil these out in order to avoid damaging the delicate edge of the inner plate. Colonies of *Crucibulum extinctorium* auct., a close relative of *Crepidula* but of a limpet or cup-like shape and with the inner plate formed into a twisted poke or cone, are also often to be found adhering to the outer surface of dead or living shells. This possesses a clearly recurved apex which, however, is usually blunted or worn away. The shell varies greatly in shape according to its environment and not infrequently bears a coloured spiral decoration ; it may also show a grooved or striated pattern impressed from the sculptured surface of the shell on which it has grown.

No record of the shells of the shore should omit mention of that sapphire harvest of the monsoon when the violet sea snails (*Ianthinidae*) are cast ashore, sometimes in prodigious numbers and still alive with their efficient floats attached, the delicate shells flung from the crests of the crashing waves and seldom suffering hurt because of their lightness and buoyancy. It requires several days of strong onshore winds to bring them from their ocean base and—this is important—one must be present when the miracle takes place ; by next day the wind will have scattered the shells far and wide and scarcely a trace will remain. The two commoner species of *Ianthina* which visit Madras are of very distinctive forms. *I. roseola* Rv. is squat in shape, the aperture three-quarters square and the shell of a heavier and stronger structure than *I. iricolor* Rv., whose larger aperture extends to a point at the base and has an outer lip of cupid's bow shape. The latter is seldom seen, although in March, 1939, I witnessed a large influx of them in all stages of growth from 5 mm. up to 35 mm. in height, many of the larger size having closely arranged egg-pouches, of a pale mauve colour, hanging from the underside of the float.

In spite of their enforced migration, a highly efficient organization

manifests itself by the presence of small jellyfishes (*Siphonophora*) which bear them company during the long voyage and upon which they feed. Many of these are also violet in tint or else a sea-green, examples being the thin circular *Porpita*, *Velella* with sail-like projection set diagonally across its raft, and the Portuguese man-o'-war (*Physalia*), all of which are invariably found on the shore in large numbers along with *Ianthina*. Young *Ianthina* sometimes drift to the shore in the early months of the year; even the tiniest of these, barely 2 mm. in height, is provided with its float several times the size of the shell. At the time of low tide the white, frothy appearance of the float bubbles and the brilliant blue shells sparkle in the sunshine on the smooth wet sand. At similar seasons, and apparently forming a unit of the flotilla, may also be found the acrobatic little *Glaucus marinus* (Du Pont)—but this is a shell-less mollusc and therefore outside the scope of these notes.

The Fishing-Nets

It is worth while to be at hand when the great drag-nets or *periyavalai*, taken a mile or so out to sea by Masula boat, are hauled in to shore. These frequently provide something new or desirable if one is quick enough, and lucky enough, not to miss the prize as it slides elusively out of sight to be lost irremediably in the mass of soft palpitating bodies of fishes of all shapes and sizes, cuttles, medusae, crabs, and sea-snakes which are brought in with each haul. Incidentally, the collector would be well advised not to stand in the sea in the vicinity of the jellyfish which have to be cast out of the nets particularly during March and April. The slightest contact will set up a painful irritation and the affected part should immediately be rubbed down with sand and sea-water. A local cure is the application of tamarind paste. The villagers' name for jellyfish is *sori*, meaning itching. By means of these nets and particularly from a similar but smaller type of net known as *turi* which is used for ground trawling, being operated from two catamarans out to sea, many of our larger shells, usually in living condition, may be secured. I here mention some of these without adopting any particular order.

Harpa conoidalis Lam. is the sole representative of the family Harpidae. The shell is sturdy, richly decorated, and gloriously polished within. The inhabitant, at any effort to draw it forth, detaches the hinder and deeper coloured portion of its foot, which is left in one's hand in a most disconcerting way, much as the gecko with its tail. This solid fleshy attachment is fitted into a groove running along the posterior edge of the foot proper and comes away with very little pressure, leaving a clean undamaged

socket which reminds one of the spring-back binding of a certain type of loose-leaf album. The amputation can be, and is, performed without adventitious aid, as occurred with a fully grown specimen which was being kept under observation in a bowl of sea-water; this individual climbed over the edge of the bowl and tumbled out leaving the lobular appendage behind. On another occasion this part detached itself and fell to the ground when a specimen was being transferred from one bucket to another, the shell being held mouth downwards and without any contact with the inmate. My largest specimen of this shell, collected at Madras, measures 95 mm. in height and 68 mm. in diameter.

The Conidae, with narrow operculum which is not always easy to locate, provide at least half-a-dozen species. *C. figulinus* L. is the common form with thick brown shell, but *Conus amadis* L. is of outstanding beauty both in colour and brilliance of polish, varying considerably in design and fairly plentiful.

The Ficidae or fig-shells number three species, all of them with delicately graved reticulate pattern and thin outer lip whose fragile edge, in the growing shell, requires the greatest care in cleaning to avoid chipping.

The Muricidae are well represented, many being provided with formidable defence works such as *Murex virgineus* (Röding), and the spiny *M. tribulus* L. Some *tribulus* develop a distinctive sculpture, the main feature of which is the number of transverse ridges between each of the major spines which varies from five to eight instead of the usual three. In addition the tubercles on the body-whorls of the former are closer set and more numerous; until young specimens of the former type have been found it must be assumed that the variation is merely a late development of the same species. The delicate *Murex pinnatus* Swainson, with feathery fin-like varices, is also worthy of special mention.

Cymatiidae, of which some half-dozen species may be secured, are of strangely irregular shape and furnished with fringes of strong bristle-like hairs along the crests of the varices.

The Tonnidae are represented by four species of which *Tonna dolium* (L.) = *maculata* (Lam.) comes ashore in large numbers. The protoconch is a tiny, smooth, amber-coloured spiral globe and bears no resemblance to the developed shell, but will be readily recognized by an examination of the apex of a mature specimen. A series of this shell showing the different stages of growth, the thickening and strengthening of the shell and the development and final fading away of the colour pattern as the supply of pigment becomes inadequate for the adornment of the expanded surface, can easily be formed.

Amongst the Pectinidae is the beautiful *Amusium pleuronectes* (L.), known as the "sun and moon shell", with the left or upper valve of livid hue and the other a dead white. This lamellibranch gets caught up in the nets a few miles south of Elliot's Beach, off Tiruamamoor, the adults arriving early in February, apparently for spawning as the spat and growing shells are in evidence from early March until June. Full-grown specimens measure up to 81 mm. both in length and height. *Amusium*, in common with other members of the Pectinidae, is active in its movements and, if placed in a large basin of sea-water may be seen to dart about with an amazing quickness of action. The animal is provided with a hundred or so eyes of different sizes, round and staring like those of a doll, which are placed at odd intervals among the waving filaments which fringe the edge of the upper mantle just inside the rim of the shell. I have counted up to 106 such eyes in one individual.

Madras can claim about forty species of the family Veneridae among which three *Paphia*, commonly brought in from the deeper sea during the latter months of the year, deserve special mention by reason of their colouring and brilliant sheen, namely *P. alapapilionis* Röding (83 mm.), *P. textile* (Gm.) (66 mm.), and *P. gallus* (Gm.), also known as *P. malabarica* (57 mm.); the measurements given in brackets are the lengths of the largest specimens so far collected by the writer. Mactridae, too, are plentiful, amongst which *Mactra turgida* Gm., swollen out as its name implies and with umboes violet-tinged, is notable for its size, as is also the gaping *Cultellus maximus* (Gm.), of the Solenidae, which exceeds 5 inches in length.

Volva sowerbyana (Weink.), a small relative of the *Cypraeidae*, is rarely taken in live condition. The mantle fringe is dotted with bright spots of deep orange colour and the shell itself has an attractive sheen which, however, soon wears off.

Hydatina velum (Gm.), light as a bubble and measuring up to 46 mm. in height and 4 inches in circumference, is brought to shore in fair numbers about July and again towards the end of the year. To see the animal fully exserted and expanded, with frills and flounces most attractively fringed with purple, fills one with amazement that so much can come out of so little. To tuck itself in again requires delicate adjustment and takes time.

The true *Cassis* is not known at Madras but there are four species of the genus *Phalium*. These have brightly decorated shells, particularly *Phalium areola* (L.). *P. glaucum* (L.) has also a very handsome shell which grows to 4 inches or more in height. The animal is beautifully coloured in orange, brown, etc., the

mantle being bordered with a brown edge. This is capable of expelling a purple fluid which will soon discolour a bucket of water.

Of the Strombidae, which are well represented in the Gulf of Manaar, two species only appear to have found their way as far north as Madras ; *Strombus succinctus* L., whose shells, with expanding outer lip and measuring about 2 inches in height, are very occasionally brought in. These are invariably tenanted by hermit crabs, no living specimen having so far been taken. The young shells up to $\frac{3}{4}$ in. are not infrequently found on the shore. Madras's other Stromb is *Rimella cancellata* (Lam.), a most attractive little shell of about 1 inch.

A few miles south is located the local chank bed, to judge by the number of *Xancus pyrum* (L.) brought in. These are of the Tanjore tribe, fully turbinate and with flesh-tone colouring within. This is a truly handsome shell although not so highly prized for the bangle industry as the purer white and more spindle-shaped *X. rapa* (Lam.) of Tuticorin. Young shells of both these species are as a rule brightly decorated with closely set rows of brown spots. The egg-case of this mollusc is occasionally washed up during the early part of the year, in shape reminiscent of a goat's horn, with numerous segmental divisions stuffed with embryonic shells. The nipple-like protoconch persists in the full-grown shell as also in *Tudicla spirillus* (L.), of the same family, which is also found in this locality.

Few collectors can boast the possession of a sinistral chank. This well-known variety commands fancy prices partly on account of its scarcity but chiefly because it possesses a religious significance in Hinduism and Buddhism, which ensures a keen demand locally at all times. At long intervals one of these desiderata comes on to the market, the price realized for a medium sized specimen being usually about Rs.500 to Rs.800, although much higher sums have been paid. Unfortunately there is no record of the number of sinistral chanks taken off the east coast of India, the Tanjore Chank Fishing-rights having been leased out by Government to contractors except for two or three seasons only when it was worked departmentally. During these years, out of a total catch of 57,324 shells, there is no record of a sinistral chank having been taken. The Tinnevelly Chank Fishery at Tuticorin has remained under strict Government control for many years. The records in this Department show that only two sinistral, or *valampuri* (meaning " right twist ") chanks were taken during the twenty-four years from 1914—one in 1930 and one in 1937—out of a total annual catch which, in recent years, has averaged between 300,000 and 400,000

shells. The fortunate diver who brings in a specimen receives a reward of one thousand times the price of a normal shell, which, at the present rate of one anna per shell, would amount to Rs.62, i.e. 8*s*. From what I can gather it would appear that the sinistral variety of *X. rapa* of the Gulf of Manaar is much scarcer than that of *X. pyrum*, the Tanjore or Madras species.

The only other sinistral shell that I have seen from South Indian waters was a specimen of *Marginella angustata* Sowerby.

Many minor freak formations may be found such as in *Murex tribulus* L., whose normally straight canal is sometimes sinuous or twisted, and *Rapana bulbosa* (Dillwyn) with scalariform whorls. *Thais bufo* (Lam.) develops a remarkable thickening of the columellar lip which may even engulf the apex of the shell and was made a separate species by Lamarck under the name *callosa*. In another category are the malformations due, for the most part, to some early fracture and subsequent repair which has interrupted the orderly growth of the shell or disturbed the normal position of the varices or other processes, such as occur in *Murex* and *Volema*. From a similar cause damage to the mantle may affect the supply of pigment resulting in the colour-pattern of the shell changing or even vanishing altogether. I have examples of these in *Natica alapapilionis* (Röding) and *Tonna dolium* (L.). Albinism is of frequent occurrence amongst some of the brightly coloured bivalves such as Tellinidae as well as in certain gastropods, for example *Drillia crenularis* (Lam.) and *Turricula tornata* (Dillwyn). I have also seen a striking example in *Conus amadis* L., which normally boasts a resplendent coat of brown and gold.

Our only Volute is *Cymbium*, the melon-shell, which grows to nearly a foot in height and twice this measurement in circumference. The animal wears a handsome mantle decorated with yellow and dark-brown stripes, depicted on the shell in the earlier stages of growth, while the interior of the shell has a beautiful satiny sheen. These are fairly plentiful, particularly towards the end of the year.

The best collecting period from the nets is from December to February when the mature molluscs apparently return each year to their spawning grounds in the shallower depths reached by the smaller trawling nets, say, perhaps, of 10 to 15 fathoms.

Dredging.

To explore with a dredge the sea bed of Royapuram Bay, and such depths as can be dragged by hand from a small boat yields a rich harvest of various dwellers in mud and sand.

With the first haul one is almost certain to see *Babylonia spirata*

(L.), a powerfully built mollusc which, when dropped into the Kilner jar, immediately begins to throw its weight about in its endeavour to force an escape, much to the discomfiture of its fellow-captives. The aperture of the shell is usually of a highly glazed porcellanous white but a variation also exists in which the mouth and columella area are coloured a fulvous yellow. The two varieties are very distinct. Furthermore, the shell normally has a deeply excavated umbilical opening but specimens, usually larger, are not uncommon where the lower part of the columellar lip has folded backwards and spread over this opening until the umbilicus is completely obscured. The mature shell is generally about 2 inches in height but specimens are found exceeding 2½ inches. *B. zeylanica* (Brug.), a scarcer member of the family, is remarkable for the bright violet colouring within the umbilical opening.

Several species of *Mitra*, including *Vexillum*, and of *Cancellaria* will be found as well as the very striking staircase-shell, *Architectonica*, with its variations in design, its brightly coloured decorations and peculiar pegged operculum.

Volema pugilina (Born), one of the largest shells of the coast, is obtainable here and, at the other extreme as regards size, *Phacoides macassari* (Prashad), a tiny spherical bivalve of extraordinarily deep sculpture, which barely fills the 5 millimeter gauge in any direction.

The Conidae and Terebridae, of the tribe Toxoglossa, whose members are provided with a poison-gland, occupy an important place amongst the Madras mollusca. In addition to the Coninae, whose sole genus *Conus* we have already noted, the Conidae family is divided into the sub-families Brachytominae, Cytharinae, and Turrinae, the shells having a sinus or slit at the upper end of the labrum which at one time earned for them the descriptive group-name of Pleurotomatidae. Madras can claim about forty species of these "slit-lips", many of them obtainable by dredge.

The local Terebridae, numbering some fifteen species, display considerable diversity in design and colour pattern. In size they vary from the ½ in. *Terebra tenera* Hinds, to a height of close upon 5 inches in *T. commaculata* (Gm.). Many of these are fairly plentiful at a depth of from 15 to 20 fathoms, both out from the harbour and farther south. *T. eximia* Dh., reputedly a shell of some rarity, apparently pays seasonal visits to Madras waters a few miles south of Elliot's Beach, the empty shells, in fairly fresh condition, but generally with a hermit crab in possession, being not infrequently brought up in the fishing-nets during the north-east monsoon season. There are two varieties of *T. eximia*

with three and four narrow bands respectively between the main spiral bands. No living specimen has yet been taken locally and my efforts to locate their place of settlement have resulted only in the capture of a dead specimen obtained at a depth of 15 fathoms. The shells measure up to slightly over $2\frac{1}{2}$ inches in height.

Marginella ventricosa Fischer with deep olive-green shell which soon fades to a dove grey on exposure to the air, is a gem which should be preserved as long as possible in the home aquarium in order to mark the bejewelled decoration of mantle and tentacles. *M. angustata* Sowerby, of brilliant polish, is plentiful in all stages of growth.

Philine is an interesting creature, to outward appearance a lump of white, rather solid, jelly. Careful dissection is necessary here in order to expose, without fracture, the gossamer-thin shell within and the gizzard plates which are so well fitted for crunching the shells of smaller mollusca for food. It may happen that a tiny shell is actually in place for cracking at the moment of capture. *Sinum*, a relative of *Natica*, also has the shell hidden within the flesh and likewise requires delicate handling. *Ancilla* is unable to retire wholly within its smooth ivory-like shell but in this respect cannot be compared with the internal shells of *Philine* and *Sinum*.

Arcidae are in abundance and in varied forms which include the hirsute *Barbatia*, the strange twisted *Trisidos tortuosa* L. and, in the mud deposit off the East Quay, at a depth of 6 fathoms, *Cucullaea concamera* (Brug.), which is provided with a cup-like compartment in each valve for the attachment of the anterior adductor muscle. *Glycymeris*, a relative of *Arca*, is also plentiful.

The nut-shell (*Nucula*) with nacreous interior and the tiny *Nuculana*, whose shells are never to be found on the shore in fresh condition, are obtainable in Royapuram Bay in 6 to 8 fathoms. Two varieties of *Nucula* are common, one with smooth rims and the other with the interior of the margins finely serrated. *Aloidis*, better known by its synonym *Corbula*, with misfit valve, is another of the smaller lamellibranchs, several species of which will be taken from the same fishing-ground.

Tellinidae are well represented, also cockles (*Cardium* and *Cardita*), the razor-fish (*Ensis*), *Cultellus*, and *Pandora*. *Cardium asiaticum* Brug., odd valves of which are common on the beach, in live condition has the radiating ridges set with sharp-pointed spines and delicate laminae which are absent in beach specimens.

Among the sea-urchins there are two species, *Temnopleurus toreumaticus* and *Salmacis rubricinta* (?), which play host respectively to species of *Eulima* and *Stylifer*, whose minute shells may be found attached between the spines. The Holothurians

or sea-cucumbers should not be thrown back without inspection. If the long-fingered starfish, *Linckia*, should make its appearance it should be searched carefully for a small Capulid of the genus *Thyca*, though I must confess that it has so far eluded me.

The Harbour.

Residents of Madras may be surprised to learn that upwards of fifty different species live in the harbour, some preferring a site to seaward although battered constantly by the waves, others choosing the tranquil waters within.

The harbour floor consists of a slimy, soft mud which is practically devoid of mollusc life with the exception of very occasional specimens of *Pandora*, *Paphia*, and *Cancellaria*, which can be obtained under pleasanter conditions out to sea. The large buoys or ships' moorings in the centre of the harbour are also disappointing, being overcrowded by *Mytilus viridis* L. to the exclusion of aught else. The collector is recommended to steer his boat to the inner quay on the northern side where good "bags" can be secured amongst the submerged agglomeration of seaweeds, sponges, hydroids, and other sea-growths rooted to the wooden piles. The Lamellibranchia are almost exclusively of the fixed type, that is either cemented to the piles or to each other, or anchored by a byssus. Amongst the former are the massive *Chama* and *Spondylus* whose rough surfaces often bear strong outgrowing spines, the interiors being flushed with purple-rose. Of the byssus-forming mollusca a fairly representative collection can be formed, amongst which will be counted three or four species of Arcidae, of which *Arca lateralis* Rv. develops an interior plate or shelf-like septum although not so pronounced as in the case of *Cucullaea concamera*. Others are the oysters and mussels including the allied forms *Anomia*, *Septifer*, *Malleus*, and *Isognomon*, the last with a hinge reminiscent of a "zip" fastener. *Lima lima* (L.), whose fringe of red and white filaments in constant motion is fascinating to watch, is provided with a beautiful pure white shell.

The Gastropoda are about equal to the bivalves in numbers. *Euchelus asper* (Gm.) with rounded whorls, a Trochid of solid mother-o'-pearl, flourishes in large numbers throughout the year along with the flattened and sharply ridged sub-variety *tricarinatus*. *Gyrineum natator* Röding, a neatly sculptured Cymatiid shell attaining a height of at least 2 inches, will also be found in abundance, particularly during the early months of the year. Species of *Engina*, *Pyrene*, *Drupa*, and *Thais* also live here.

Of the dozen species of cowry known to Madras, three at least make their homes here, viz. *Cypraea arabica* L., *C. pallida* Gray,

and *C. ocellata* L. The last-named, decorated with brightly coloured ocelli, is a brilliant shell which it would be difficult to recognize in beach-worn specimens. Others attracted to this rich pasturage include the keyhole limpet, *Diodora lima* (Sow.) and the scarcer *Amalthea tricarinata* (Gm.). The latter challenges close scrutiny, being almost indistinguishable in its brown jacket, clinging limpet-like to a pearl oyster or gigantic mussel.

During the cold-weather months of 1938–9, large numbers of the small limpet-shaped brachiopod *Discinisca indica* Dall appeared. At low tide in the same area a Chiton should be looked for just above the sea level. This belongs to the genus *Acanthochitona* and may exceed 1 inch in length. It can be recognized by the tufts of strong bristles (eighteen in number) which decorate the margin or girdle. Numerous specimens of *Cypraea arabica*, already found on the piles, some reaching a basal measurement of 3 inches, and an occasional immature shell will also be found at low water, lurking in the deep fissures in the north wall.

Higher up on the harbour wall, near and above the sea mark, are to be found *Littorina scabra* (L.), in vast quantities, of varied pattern and colour, and the local *Planaxis sulcatus* (Born) which is smaller than the Pamban and Tuticorin shell. A *Siphonaria*, that strange pulmonate of limpet form, will also be found here and the true limpet, *Patella* (*Cellana*).

The limpets, of which there are two or, possibly, three species, and several species of *Thais* thrive on the rocks outside the harbour walls. Small chitons, *Plaxiphora indica* Thiele, may be taken clinging to the barnacle-roughened walls or lying closely hidden under the sea moss which covers the submerged concrete blocks of the breakwaters. This moss also provides cover for the dainty little *Pyrene terpsichore* (Sow.). *Venerupis macrophylla* Dh. should be looked for in chinks in the rocks where it lies securely wedged, although at times also found among the algae.

An opportunity should be watched for to explore the pools at the base of the blocks of concrete piled up in the fork at the northern end of the East Quay. Suitable conditions of low tide, combined with a westerly wind to check the incoming swell, will be met with during July. This exclusive site possesses a distinctive fauna which includes several mollusca not to be found elsewhere at Madras. Pride of place must be given to a large colony of *Turbo argyrostoma* L. clinging to the outer rocks at or just below sea-level; these are in such numbers that a handful of three or four at a time can be gathered. *Nerita albicilla* L. and *Nerita chamaeleon* L. will be noticed higher up on the rocks. Nerites have the nocturnal wandering habits of land-snails and are best collected after dark,

but the seeker by torchlight will find his task no easy one. It is strange that the shells of *Turbo* and *Nerita* are never found on the Madras shore, but this may be accounted for by the viscid nature of the soft mud of the harbour channel into which any old or dead shells must fall and sink deeply.

At one point occurs an unsuspected crop of coral (*Pocillopora*) within the thick stems of which will be discovered specimens of *Gastrochaena* and *Lithophaga ;* in another pool a densely rooted seaweed furnishes a secluded retreat for *Arca navicularis* Brug. Groups of a tiny *Arca* (*sculptilis* Rv.) will be found nested together in the hollowed undersurface of submerged stones. Numbers of the richly coloured *Thais rudolphi* Lam. congregate at the head of narrow fissures in the rocks while *Thais intermedia* Kiener (= *hippocastanum* auct.) and two or three species of *Drupa*, and other rock climbers noticed elsewhere, are plentifully represented.

Cypraea arabica is particularly abundant, three distinct forms of the shell being present ; two with dorsum of the flattened shape usual to Madras, one narrow and the other broad, the ratio of width to height ranging from ·54 to ·69, and a third with humped back sometimes separated as *histrio* Gm.

A straying *Bursa granularis* (Röding) or *Murex torrefactus* Sow. is indicative of other desirable things which may be clinging to the underside of the rocks deep in the sea. How to get at them is the problem ! Here, if anywhere, should be the haunt of *Haliotis* if an unconfirmed report that it has actually been taken at Madras is true.

The rock-oyster (*Ostrea forskalii* Gm.) will be noticed growing thickly at about tide level both inside and outside the harbour. A hammer and chisel will be found necessary in order to obtain a complete specimen. The empty valves adhering to the walls and rocks offer a favourite resting place to the small *Nerita* already mentioned.

The end of the projecting South Wall provides a swarming ground for countless numbers of small Littorinidae, particularly *Littorina malaccana* Ph. and *Littorina ventricosa* Ph., as well as a tiny reddish-brown *Assiminea* (?) which spreads like a fine gravel over the spray-drenched areas.

The Backwaters.

In the backwaters at Ennur, as well as in the Adyar basin, will be found representatives of several genera which, although at home under brackish conditions, are so closely connected with the sea as to justify inclusion amongst their purely marine kindred.

Of such are several of the *Tellinidae* including the blood-red

Tellina cuspis Hanley (at times, but rarely, a shining white), *Neritina*, fluviatile forms of *Nassarius*, *Cerithidea*, and the brightly and variously coloured button shells, *Umbonium vestiarium* (L.), which are fully grown about April-May. In their turn some sea-dwellers find their way into this territory for feeding and breeding purposes. These include several species of *Arca*, a small cockle, oysters, *Donax*, *Volema*, *Oliva*, and *Natica*; the egg-ribbon of *Natica* is in evidence from April onwards. Other marine molluscs to be taken here include *Turritella duplicata* (L.), *Conus figulinus* L., *Paphia gallus* (Gm.), and the diminutive *Nuculana mauritiana* (Sow.). The last group may be regarded as chance visitors swept in by the tide before the closing of the sea channel; nevertheless they accommodate themselves to the changed conditions in which they find themselves and appear to thrive.

In these peaceful retreats the sea-hare pursues its quiet way. *Aplysia cornigera* Sow., which is the form commonly to be found at Ennur, exceeds 7 inches in length, its heavy, lumpy body being mottled with patches of grey and a dull sage-green, the darker shadings bearing a distinctive mosaic pattern. The Adyar sea-hare, probably a form of *Aplysia tigrina* Rang, with hood and mantle-folds richly ornamented in a close-set intertwining or maze-like pattern of bright olive-green on a grey background, is a gorgeous creature. The internal "shell" or shield of *Aplysia* is a transparent membranaceous affair measuring upwards of 2 inches in height and rather less across; the Ennur species has a more sloping shoulder than the other. *Bursatella*, sometimes misnamed *Notarchus*, adorned with jewel-like ocelli and variously coloured in deep brown, grey, or a bright golden-rust, is a close relative of *Aplysia* and makes its appearance in large numbers during the spawning season both in the Adyar and at Ennur. A microscopic spiral shell of nautiloid contour is present in the embryo.

At this season, in February and March, the weed-grown shallows will be found to be teeming with life in a wide variety of forms. Particularly so is this the case in the Adyar waters. The ubiquitous *Cerithidea cingulata* (Gm.) will be observed browsing in this rich feeding-ground and in the mud at the roots of the mossy weeds there may be collected a fair range of gapers, including several varieties of *Laternula*, whose paper-like, hyaline shells of a frosted whiteness require the greatest care in handling. These carry a fracture-like scar traversing both umbos but should not be discarded on this account, the condition apparently being normal. *Standella pellucida* (Gm.) is also present, its lurking-place revealed by the attenuated siphon which protrudes 4 or 5 inches from the mud.

Periodically, with each spawning, the sea-grass and weeds will be found crowded with myriads of a small spiral Rissoa-like shell which reach a "fledgling" stage in the course of two or three weeks and suddenly and mysteriously disappear. In the same way swarms of juvenile *Natica*, *Umbonium*, and *Nassarius*, may be noticed shortly after hatching, at odd times in different pools, throughout this period. These also quickly achieve a state of independence and disappear suddenly but are later easily retrieved from the river mud and sand at a depth of from 4 to 8 inches. The sea-grass harbours also the jewel-like *Smaragdia oualaniensis* (Lesson) and *Neritina siquijorensis* Récluz, both attractively adorned with variegated mosaic-like patterns. *Neritina* should also be looked for adhering to the inside of an old oyster or other shell. Young oysters, both *Ostrea madrasensis* Preston and *O. forskalii* Gm., may also be noticed in large numbers astride the shells of *Cerithidea cingulata*, to which particular species they show a remarkable constancy, inevitably to become an embarrassment to both parties as the newcomer quickly outgrows its allotment. These top-heavy shells are often tenanted by hermit-crabs.

At Ennur the larger Arcidae and *Telescopium telescopium* (L.), a ponderous Potamidid of 5 inches, the interior of which is smoothed over with a thick layer of plum coloured enamel, are fairly common in the soft exposed mud. The latter are particularly plentiful in the northern reaches of the backwaters at Covelong where the black mud acquires a slimy consistency to its liking.

A number of other species can be gleaned from the sand and mud with the aid of a sieve. In this manner we have secured at Ennur specimens of the lively little razor-shell, *Neosolen aquaedulcioris* Ghosh, and both at Ennur and Adyar several species of *Nassarius* and *Tellina*, which lie closely hidden a few inches below the surface of the mud, the familiar window-pane oyster (*Placenta placenta*), some of the smaller Trochidae such as *Euchelus* and *Minolia*, and a $\frac{1}{2}$ in. *Eulimella* (*?*) sp. in amazing quantities considering that the empty shell is of the rarest occurrence. This last is seldom seen alive on the surface. Its laborious method of progression by advancing the small blood-red foot about a millimetre at a time, taking a grip on the sand and then hauling the shell along, repeating the process with a distinct pause at each stage of the completed movement in what can be described as a furtive manner.

During the dry-weather months of March to May each year the exposed surfaces of the sand-banks of the Adyar are scattered over with the thick shells of the popular edible "mat-tee" (*Meretrix casta*) and other clams belonging to the Venus family. The empty valves of *Sanguinolaria* and the small slender *Solen annandalei*

should also be looked for at the same time. The latter runs from barely 1 inch in length early in February to fully 3 inches in July. These bear a general resemblance to a broader and stoutly formed 4-inch shell, possibly *Solen lamarckii*, which is brought in from the sea between August and October.

Still later, in the months immediately preceding the south-west monsoon, a visit to Ennur will reward the collector with a very fair series of *Littorina*, both *L. scabra* (L.), whose colour-phases range over a choice of shades in yellow, brown, purple, and red, and the more attenuated *L. melanostoma* Gray, which may be gathered from the little white mangroves and marsh herbs of the muddy flats.

One should not omit to record the brachiopod *Lingula* which is to be found deep in the mud at the St. Thomé end of the Adyar basin. The brilliant colouring and sheen, the swivel-action of the hinge and the cilia in constant movement combine to make it a most fascinating creature to watch.

I should like to express my appreciation of the assistance so readily given at all times by the Museum and the Fisheries Department authorities in Madras.

CYPRAEIDAE FROM ATAFU ISLAND, UNION GROUP.

By William Marcus Ingram.
Zoology Laboratory, Cornell University.

(*Read before the Society, 11th March, 1939.*)

The Union or Tokelau Islands are situated in 9° 00′ South Latitude and 172° 00′ West Longitude. They consist of three groups of coral islets whose reefs enclose lagoons, and they extend in a northwest–southeast direction.

Atafu (Duke of York Island) is the northernmost of the three, lying 8° 34′ S. and 172° 40′ W. A fringing reef surrounds the islets of this atoll and extends as far as 1,000 yards from the north-west islet. There is no opening into the lagoon except from water pouring over the reef.

Certain species of cowry are abundant in the waters about Atafu. The shells upon which this paper is based were gathered by Mr. Gordon MacGregor of the Bernice P. Bishop Museum, Honolulu, and are now housed in this museum. Twenty-three species are represented in the collection, and of these, eight species are apparently quite prolific in this locality. The most common species, judging from and listed in order of their abundance in the collection, are: *Cypraea isabella* Linnaeus, 2,055 shells; *Cypraea poraria* Linnaeus, 2,025 shells; *Cypraea moneta* Linnaeus, 1,553 shells; *Cypraea irrorata* Gray, 1,533 shells; *Cypraea intermedia* Gray, 1,142 shells; *Cypraea ventriculus* Linnaeus, 449 shells; *Cypraea nucleus* Linnaeus, 407 shells, and *Cypraea carneola* Linnaeus, 229 shells.

One oddity is noticeable upon examination of the following list, namely the absence of *Cypraea lynx* Linnaeus. It would seem certain that if this species were at all common it would be found in this fine and complete collection. It occurs quite abundantly in the Samoan Islands, which lie not far from the Tokelaus, and specimens in the Bernice P. Bishop Museum show that it is also found at near-by Danger Island.

C. annulata Gray.

C. annulus Linnaeus. Shells all greyish-blue within annular ring. Annular ring in majority of specimens is pale yellow; in a few it is deep orange.

C. arabica Linnaeus. A large specimen is 63 mm. long.

C. arenosa Linnaeus.

C. argus Linnaeus. The largest specimen is 75 mm. long.

C. caputserpentis Linnaeus. The shells are typically of the South Sea form.

C. carneola Linnaeus. All individuals are of the small variety.

The largest measures from the anterior–posterior extremities 38 mm., and the smallest 19 mm. The measured shells are mature.

C. cicercula Linnaeus.

C. fuscomaculata Pease.

C. helvola Linnaeus.

C. intermedia Gray. One individual is extremely large, measuring 48 mm. along the anterior–posterior axis.

C. irrorata Solander.

C. isabella Linnaeus. Some individuals of this species resemble the Hawaiian Island form in that the anterior and posterior dorsal canal regions, orange in colour, have superimposed brown blotches. Other shells are typical of the South Sea forms.

C. margarita Sowerby.

C. mauritiana Linnaeus. All specimens have an orange-brown blotch over the dorsal canal extremities. The reticulated pattern is very distinct in all individuals. A large specimen is 91 mm. in length. It is interesting to note that three of these shells are atypical from the species as a whole in being unusually long in proportion to their width along the anterior–posterior axis.

C. moneta Linnaeus. A large individual measures 30 mm. along the anterior-posterior axis. In some a light yellow annular ring is present. The range in colour is from slate-white to deep yellow-orange.

C. nucleus Linnaeus. Only individuals that are too young to have yet developed the dorsal tubercles or nodules are present in the collection.

C. poraria Linnaeus.

C. punctulata Gmelin.

C. talpa Linnaeus. The largest individual is 82 mm. in length, and is coloured a dark blackish-brown.

C. tigris Linnaeus. Five shells range in colour from white with scattered blackish and brownish dots to a brown blotched dorsal colour pattern. The largest specimen is 110 mm. in length and the smallest 75 mm.

C. ventriculus Lamarck. The marginal filling in mature specimens appears to be darker than normal, approaching a blackish-brown.

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN & IRELAND.

661st Meeting (War Emergency Annual Meeting) held at the British Museum (Nat. Hist.), London, S.W. 7, on 24th November, 1939.

The President, Capt. C. Diver, in the chair.

Present.—Messrs. A. E. Ellis, A. E. Salisbury, G. L. Wilkins, A. S. Kennard, H. C. Fulton, Lt.-Col. A. J. Peile, and J. R. le B. Tomlin (Acting Secretary).

Apologies for absence were received from Hon. Secretary, Hon. Treasurer, A. Blok, R. Winckworth, R. H. Moses and Miss Robertson.

Appointment of Auditors.

Messrs. C. H. Moore and A. K. Lawson were re-appointed auditors.

Candidates for Membership.

W. E. R. Hackett, Snugborough, Blackrock Road, Cork (introduced by A. E. Ellis and J. W. Jackson).

Miss E. A. Bush, 58 Freehold Street, Coventry (introduced by W. F. Lloyd James and J. W. Jackson).

W. G. Geakings, 44 Locking Street, Nelson, New Zealand (introduced by Mrs. E. M. Morehouse and J. W. Jackson).

J. H. Clarke, 1246 South Hope Street, Los Angeles, California, U.S.A. (introduced by Mrs. E. M. Morehouse and Mrs. J. E. Whitmore).

J. M. R. M. Viader, M.B.E., Vacoas, Mauritius (introduced by J. R. le B. Tomlin and A. J. Peile).

John Wharton, F.I.C., A.M.I.Chem.E., Lyndene, Weston Road, Runcorn (introduced by J. W. Jackson and A. E. Ellis).

P. O. Barnett, 133 Faraday Avenue, Sidcup, Kent (introduced by J. E. Cooper and G. L. Wilkins).

Annual Reports.

The Annual Report of the Council, the Reports of the London and Leeds Branches and those of the Curator and of the Recorders were presented and adopted.

Election of Officers and Council.

The Officers and Council for 1939–1940, nominated by the retiring Council, were duly elected (see p. 185).

Votes of Thanks.

A vote of thanks was passed to the authorities of the Manchester Museum for the use of rooms for the Society's meetings.

Votes of thanks were also passed to the retiring President, and to Mr. Chas. Oldham who is giving up the Treasurership after 22 years' service.

ANNUAL REPORT, 1938-39.

This is the Sixty-Third Annual Report. Since the last Annual Meeting the Society has suffered losses in membership by four deaths, five resignations, and one removal, a total of ten. The elections of new members amount to eight, and the membership now stands at 205, including Honorary and Institutional members. In addition there are the seven candidates nominated to-day.

The deaths during the year are Professor J. W. Carr, Mrs. Gill, Professor Shintaro Hirase, and the Rev. W. A. Shaw.

Four ordinary meetings have been held at the Manchester Museum

by the continued permission of the authorities. In addition, a successful joint meeting was held at Leeds in November, 1938, and a similar one at Manchester in April, 1939.

Fourteen papers and notes have been read, and there were three Special Exhibits.

Since the last Annual Meeting three numbers of the *Journal of Conchology* have appeared, viz. vol. 21, nos. 4–5 (double-number), 29th March, 1939, with 64 pages of text, 1 plate, and 2 text-figures ; no. 6, 21st September, 1939, with 32 pages of text, and 5 text-figures.

The Council has approved the preparation of a Revised Census of British Non-Marine Mollusca, and a Revised Check-List of British Non-Marine Mollusca. Both are well in hand.

Owing to ill-health Mr. Charles Oldham has been compelled to resign the post of Hon. Treasurer after twenty-two years of faithful service. The Council takes this opportunity of thanking him for his unremitting attention to the financial affairs of the Society.

It is unfortunate that a state of war has somewhat curtailed the activities of the Society and has brought about the suspension, for a time, of the ordinary monthly meetings. Several of the members, including the Hon. Secretary, are engaged upon important war work. A further result of the war has been the taking over of the large basement at the Manchester Museum for the purpose of a public Air Raid Shelter. This has led to the displacement of the Society's Library and Collections, thus rendering them inaccessible for the present.

The first draft of the new list of British Non-Marine Mollusca is in manuscript and is in circulation among various students for criticism and comment. It will embody the general consensus of opinion and it is hoped that it will shortly be ready for the press.

Additions to the Library during the year have been received from Mrs. McMillan, Dr. H. Schlesch, Dr. J. W. Jackson, Dr. C. H. Madge, G. C. Spence, C. Oldham, Jules Favre, H. H. Bloomer, A. Myra Keen, Don L. Frizzell and T. van Benthem Jutting.

Donations to the Cabinet have been made by Mr. C. Oldham (shells of *Zoogenetes harpa*, from Riffelalp, Zermatt, 7,000 ft.), and by Dr. H. Schlesch (ten photos of conchologists).

RECORDER'S REPORT (NON-MARINE MOLLUSCA).

THE generous response to the appeal in this Journal, p. 150, has enabled the Recorder to revise many of the old records of *Succinea ;* all of them for England, Wales, and Scotland are being revised, but in Ireland where true *S. elegans* is absent the records of *S. putris* and *S. pfeifferi* have been accepted without revision.

The most interesting new record is of *Clausilia cravenensis*, collected in the Outer Hebrides by Dr. G. H. Harrison. This is the first Scottish record to be confirmed.

Potamopyrgus jenkinsi continues its invasion of south-east Scotland. In 1930 the species flourished in hothouses in the Royal Botanic Garden, Edinburgh, and was apparently absent in the surrounding district. In 1936 large numbers were found in the Union Canal in Edinburgh and its progress has been followed into Linlithgowshire where it was found for the first time this year. The Union Canal communicates with the Forth and Clyde Canal at Falkirk in Stirlingshire and the way is open for the spread of the species into Stirling, Lanark, and Dunbartonshire.

The general revision of the Census Additions has been completed and many of the maps showing distribution of the species have been redrawn. The present report embodies all the records of *Succinea* which have been re-examined by Mr. Kennard, Dr. Quick, and the Recorder.

Channel Is. (0). *Succinea pfeifferi* (J. R. le B. Tomlin).
Devon, S. (3). *Succinea putris, S. pfeifferi* (A. E. Boycott).
Devon, N. (4). *Succinea arenaria, S. putris, S. pfeifferi* (H. E. Quick).

Somerset, S. (5). *Agriolimax laevis*, *S. pfeifferi* (E. P. Blackburn).
Somerset, N. (6). *S. putris* (A. E. Salisbury), *S. pfeifferi* (A. E. B.).
Dorset (9). *S. putris*, *S. pfeifferi* (H. E. Q.).
Hants, N. (12). *S. putris* (A. E. B.), *S. pfeifferi* (A. E. Ellis).
Sussex, E. (14). *S. pfeifferi* (G. Shrubsole), *S. oblonga* (J. R. le B. T.).
Kent, E. (15). *S. putris* (J. R. le B. T.), *S. pfeifferi* (J. E. Cooper).
Kent, W. (16). *Milax gracilis* (A. S. Kennard).
Surrey (17). *S. putris*, *S. pfeifferi* (A. R. Waterston), *S. oblonga* formerly at Battersea (A. S. K.).
Herts (20). *S. putris* (C. Oldham), *S. pfeifferi* (A. E. B.).
Middlesex (21). *S. putris* (C. O.), *S. pfeifferi* (A. R. W.), *S. oblonga*, Pleistocene, Ponders End (J. R. le B. T.).
Berks (22). *S. putris* (A. E. B.).
Oxford (23). *S. putris*, *S. pfeifferi* (A. E. B.).
Suffolk, E. (25). *S. pfeifferi* (A. E. B.).
Suffolk, W. (26). *S. pfeifferi* (A. E. E.).
Norfolk, E. (27). *S. elegans*, *S. pfeifferi* (A. E. E.).
Norfolk, W. (28). *S. putris* (A. E. E.).
Cambridge (29). *S. putris* (C. O.), *S. pfeifferi* (J. R. le B. T.).
Northampton (32). *S. pfeifferi* (J. R. le B. T.).
Gloucester, E. (33). *S. putris* (A. E. B.).
Gloucester, W. (34). *S. putris* (J. R. le B. T.), *S. pfeifferi* (A. E. S.).
Herefordshire (36). *S. putris* (J. R. le B. T.).
Stafford (39). *Milax sowerbyi*, *M. gagates*, *M. gracilis* (B. Bryan).
Glamorgan (41). *S. putris*, *S. pfeifferi* (H. E. Q.).
Brecon (42). *S. putris* (H. E. Q.).
Radnor (43). *S. putris*, *S. pfeifferi* (H. E. Q.).
Carmarthen (44). *S. putris*, *S. pfeifferi* (H. E. Q.).
Pembroke (45). *S. pfeifferi* (H. E. Q.).
Carnarvon (49). *Phytia myosotis* (N. McMillan), *S. putris*, *S. pfeifferi* (H. E. Q.).
Anglesea (52). *S. pfeifferi* (C. O.).
Derby (57). *S. putris* (J. R. le B. T.).
Cheshire (58). *Peringia ulvae* (N. McM.), *S. pfeifferi* (A. E. S.).
Lancashire, S. (59). *S. pfeifferi* (A. E. S.).
Lancashire, W. (60). *S. pfeifferi* (J. R. le B. T.).
Yorks, S.E. (61). *S. putris*, *S. pfeifferi* (J. R. le B. T.).
Yorks, N.E. (62). *S. putris*, *S. pfeifferi* (J. R. le B. T.).
Yorks, S.W. (63). *Truncatellina cylindrica* (Kiveton Park, E. Pickard, in coll. Royal Scottish Museum, Edinburgh), *S. pfeifferi* (J. R. le B. T.).
Yorks, M.W. (64). *S. pfeifferi* (A. E. S.).
Durham (66). *S. putris* (coll. R. Rimmer), *S. pfeifferi* (D. K. Kevan).
Northumberland, S. (67). *Milax gracilis* (E. P. B.).
Cheviotland (68). *Vertigo antivertigo*, *S. putris*, *S. pfeifferi* (E. P. B.).
Westmorland (69). *S. putris* (A. E. B.), *S. pfeifferi* (A. C. Bond), *S. oblonga* (F. Taylor).
Cumberland (70). *S. pfeifferi* (D. K. K.).
I. of Man (71). *S. pfeifferi* (F. T.).
Dumfries (72). *S. putris* (D. K. K.), *S. pfeifferi* (A. R. W.).
Kirkcudbright (73). *S. putris*, *S. pfeifferi* (A. R. W.).
Ayr (75). *S. pfeifferi* (D. K. K. and A. R. W.), *Limax flavus*, *Limax arborum*, *Vallonia excentrica*, *Valvata cristata*, *Sphaerium corneum* (A. R. W.).
Lanark (77). *S. pfeifferi* (D. K. K. and A. R. W.).
Peebles-shire (78). *S. pfeifferi* (D. K. K. and A. R. W.).
Selkirk (79). *S. putris* (e. coll. W. Evans), *S. pfeifferi* (D. K. K. and A. R. W.).
Roxburgh (80). *S. pfeifferi* (D. K. K. and A. R. W.).
Berwickshire (81). *S. pfeifferi*, *Milax gagates*, wild (A. R. W.).
Haddington (82). *S. pfeifferi* (e. coll. W. Evans), *S. oblonga* (D. K. K.).
Edinburgh (83). *S. pfeifferi* Recent and Holocene, *Physa acuta*, Royal Botanic Garden, *Aplexa hypnorum* formerly in the "Borough Loch" drained about 1810: now extinct, shells frequent in the shell marl

of this old lake (A. R. W.); *Planorbis corneus* ? introduced (N. Sloan and A. R. W.).

Linlithgow (84). *S. oblonga* (D. K. K.), *S. pfeifferi*, *Potamopyrgus jenkinsi* (A. R. W.).

Fife and Kinross (85). *S. pfeifferi* (A. R. W.).

Stirling (86). *S. pfeifferi* (A. R. W.), *S. oblonga* (D. K. K. and A. R. W.).

Perth, W., and Cl. (87). *S. oblonga* (D. K. K. and A. R. W.), *S. pfeifferi* (A. R. W.), *Pisidium hibernicum* and *P. conventus* Loch Vennachar (coll. Nelson Annandale in Royal Scottish Museum, Edinburgh).

Perth, M. (88). *S. pfeifferi* (A. R. W.).

Perth, N. (89). *S. pfeifferi* (A. R. W.), *Truncatellina cylindrica* Kinnoull Hill (H. Coates).

Aberdeen, S. (92). *S. pfeifferi* (J. E. Forrest and A. R. W.).

Aberdeen, N. (93). *S. pfeifferi* (F. Booth).

Easterness (96). *S. pfeifferi* (A. E. B.).

Argyll (98). *S. pfeifferi* (A. R. W.).

Dumbarton (99). *Limax cinereoniger* (A. R. W.), *Helix caperata* seg. (H. Friend, in coll. W. Evans).

Clyde Is. (100). *S. pfeifferi* (A. R. W.).

Cantire (101). *S. pfeifferi* (D. K. K.).

Ebudes, M. (103). *Arion subfuscus*, *A. minimus*, *A. hortensis*, *Retinella radiatula*, *Zonitoides excavatus*, *Hygromia subrufescens*, *Acanthinula lamellata*, *Lauria anglica*, *Phytia myosotis* var. *ringens*, *Pisidium nitidum* (N. Annandale in R. S. M. Edinb.), *S. pfeifferi* (A. W. Stelfox).

Ebudes, N. (104). *S. pfeifferi* (G. H. Harrison), *Planorbis nautileus* var. *laevigata* (T. Warwick), *Acme lineata* (K. B. Blackburn).

LAND AND FRESHWATER MOLLUSCA OF SUSSEX.

In the last No. of this Journal under the above heading on p. 164 appears the statement "*Pisidium personatum* Malm from a stagnant pond at Warnham, hitherto only recorded by R. Winckworth from Chichester".

In the *Non-marine Mollusca of the Eastbourne District*, this Journal, vol. 19, p. 368, two localities are given where *P. personatum* has been found, the specimens having been identified by Mr. Oldham.

GEORGE SHRUBSOLE.

ANCYLUS AND *LIMNAEA* LIVING WITHIN REACH OF SALT-WATER.

At Greenisland, Co. Antrim, a little stream flows through the garden of the house where I used to live, and emerges fanwise on to the seashore, first cutting through a shingle bank just above H.W.M. During spring tides the sea invades the streamlet for a distance of some yards, and in stormy weather saltwater extends upstream some 30–40 feet. *Ancylus* and *Limnaea peregra* are abundant, living on the stony bottom at the very mouth of the stream, where, particularly in the winter, they must find themselves in salt or at least brackish water twice a day.

I believe that Stubbs found a similar case (*J.C.*, ix, 363, 1900), but have not seen his account.

N. McMILLAN.

ACCOUNTS FOR THE YEAR ENDED 31st DECEMBER, 1939.

Income and Expenditure Account.

Dr.

	£ s. d.	£ s. d.	£ s. d.
To Annual Subscriptions—			
For 1939—			
12 at 5*s*. .	3 0 0		
119 at 10*s*. .	59 10 0		
		62 10 0	
Arrears		3 15 0	
			66 5 0
,, Sale of Publications			19 14 8
,, Advertisements			18 6
,, Donations to Publications			5 13 8
,, Transfer from Life Membership Fund . .			16 16 0
			£109 7 10

Cr.

	£ s. d.	£ s d.	£ s. d.
By publishing and distributing of *Journal of Conchology*, Vol. XXI.			
Parts 4 and 5 .	43 3 11		
Part 6 . .	23 4 2		
		66 8 1	
Authors' Reprints	8 8 0		
,, ,,	5 2 1	13 10 1	
			79 18 2
,, Printing and Stationery			1 2 6
,, Fire Insurance			10 0
,, Warehousing Stock			1 10 0
,, Subscriptions—			
Malacological Society . .		1 1 0	
Lancs. and Chesh. Fauna Com.		5 0	
Zool. Record		5 0	
			1 11 0
,, Officers' Expenses and Bank Charges . .			4 6 0
,, Balance, being excess of Income over Expenditure			20 10 2
			£109 7 10

Life Membership Fund.

	£ s. d.
To Amount of Fund, 1st January, 1939 .	355 4 0
,, Dividend and Interest	16 16 0
	£372 0 0

	£ s. d.
By Transfer to Income and Expenditure Account	16 16 0
,, Amount of Fund, 31st December, 1939 .	355 4 0
	£372 0 0

Research Fund.

	£	s.	d.
To Amount of Fund, 1st January, 1939	269	0	5
,, Dividend and Interest	12	16	6
	£281	16	11

	£	s.	d.
By Amount of Fund, 31st December, 1939. Cap.	200	0	0
,, Accumulated Interest	81	16	11
	£281	16	11

BALANCE SHEET.

Liabilities.

	£	s.	d.	£	s.	d.
Annual Subscriptions paid in advance				3	6	5
Life Membership Fund				355	4	0
Research Fund				281	16	11
Balance of Income and Expenditure Account—						
As on 1st January, 1939	105	7	11			
For 1939	20	10	2			
				125	18	1
				£766	5	5

Assets.

	£	s.	d.	£	s.	d.
Investments.						
4% Funding Loan, £408 4*s.* 11*d.*, cost	350	0	0			
4½% Conversion Loan, £202 13*s.* 3*d.*, cost	200	0	0			
3½% Conversion Loan, £40 11*s.* 8*d.*, cost	40	0	0			
				590	0	0
Cash at Bankers				176	5	5
				£766	5	5

NOTE.—Assets in addition to those set out in the Balance Sheet are (*a*) Library, (*b*) Cabinets and Collections, (*c*) Stock of unsold publications, (*d*) Annual Subscriptions in arrear.

Audited and found correct.
C. H. MOORE.
A. K. LAWSON.
23rd January, 1940.

ALBERT E SALISBURY,
Hon. Treasurer,
31st December, 1939.

VOL. 21] **17TH JANUARY, 1941.** [No. 8

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— OF —

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MOLLUSCAN FAUNA OF BURTON MARSH, CHESHIRE.

By NORA F. MCMILLAN.

THAT determined colonist *Hydrobia jenkinsi* arrived at Burton Marsh during 1936 or possibly 1937, and it now seems time to put on record changes in the fauna and flora of the gutters *jenkinsi* now occupies.

Burton Marsh is an extensive area of land bordering the Cheshire side of the river Dee, and is mainly land reclaimed during the last century. It is now grazing land, but the flora is poor and few typical salt-marsh plants are present. The whole marsh is intersected by disconnected pools and winding gutters which extend to its extreme upper limit and are in every stage of formation, from the almost recolonized to expanses of bare mud. The whole area is tidal, but the uppermost channels are only reached by springs, and only the highest tides completely submerge the marsh, ordinary springs leaving a portion of the grassed part uncovered.

The gutters investigated are those nearest to H.W.O.S.T.; in April, 1935, it was noted that an exceptional tide had left a line of débris some 40 feet above these gutters, which vary in width from 2–6 feet, and are about 6–15 inches deep, with a bottom of soft mud.

In 1935 the fauna and flora were as follows :—

Fauna: *Gobius microps* Kröyer, abundant; *Anguilla vulgaris* Turton, one; *Sphaeroma* sp., few; neither examination of plants nor sieving mud yielded any molluscs.

Flora: *Scirpus maritimus* L. a little; blue-green algae abundant (*Oscillatoria margaritifera* Kütz. plentiful, and other spp. also present); many diatoms.

In 1937 :—

Fauna: *Hydrobia jenkinsi* Smith in myriads (no other sp. of mollusca); *Gammarus duebeni* Lillj., moderately plentiful.

Flora: *Ranunculus sceleratus* L. abundant at edges; *R. lenormandi* F. Schultz, several patches; *Nasturtium officinalis* R. Brown, abundant in highest part of gutter; *Polygonum amphibium* L. with *Nasturtium officinalis*; *Lemna minor* L., plentiful; *Zannichellia*

palustris L., in several places. Algae: *Enteromorpha intestinalis* Link, very abundant; *Vaucheria* sp. very abundant; *Monostroma* sp. fairly abundant, and a little *Cladophora* sp.

In 1940:—

Fauna: *Lymnaea peregra* (Müller) (bred spring, 1940), abundant; *Hydrobia jenkinsi* Smith, very abundant. *Gammarus* sp. and small bronze beetles frequent.

Flora: Flowering plants as in 1937, with the addition of *Apium nodiflorum* (Koch) and *Catabrosa aquatica* Beauv. Algae: *Cladophora glomerata* (L.) Kütz. abundant; *Monostroma bullosum* (Roth.) Wittr. *Enteromorpha* appeared to be absent.

The water in these gutters tasted fresh, but a sample taken 25th July, 1940, titrated with silver nitrate showed distinctly, though slightly salt.

There is a pond, much trampled by stock, in a field separated from the Marsh only by the road, and this yielded (in 1937 and 1940) abundant *H. jenkinsi* and *L. peregra*, and also *Sphaerium corneum* (L.). As a small drain runs from this pond under the road to emerge just at the fence bordering the landward edge of the Marsh it was evident that here was the source of the *jenkinsi* invasion, and at the outlet of the drain (which forms a miniature waterfall some 10 inches high) *jenkinsi* abounded, together with *peregra.*

Evidently *jenkinsi* had been introduced into the pond, and from there had spread, via the drain, to some of the top gutters on the Marsh. It will be interesting to see to what extent the species spreads; Boycott (1, p. 141) states that experimentally freshwater strains may easily be got to live and breed in sea-water, so there seems no reason why *jenkinsi* should not occupy the whole marsh, at least until the top of the *Hydrobia ulvae* zone is reached.[1]

Dr. J. W. Jackson has recorded *jenkinsi* from Wallasey in 1933 (2, p. 34) and Leasowe (3, p. 34); Burton appears to be the third known station in the Wirral Peninsula.

L. peregra has not yet succeeded in colonizing such a large extent of the gutter-system as *jenkinsi*; it has spread from the drain-outlet and so far has established itself only in those gutters directly communicating with it. In August, 1940, I examined another top gutter, about 100 yards east of the drain outlet but not in direct communication with it, and although this gutter seemed even less salt than those already investigated (shown by the presence of *Spirogyra* sp. and the characteristic freshwater form of *Enteromorpha intestinalis*) *peregra* was absent.

[1] Burton Marsh is now a rifle range, and since September, 1939, visitors have been discouraged, so that I have been unable to examine any gutters except the uppermost line.

Boycott (1, p. 142) states that *peregra* occurs in brackish marshes, and Heathcote (4) records finding *peregra* var. *boissii* Dupuy living on *Enteromorpha intestinalis* in a tidal ditch reached by every tide. The Burton Marsh specimens seem close to var. *boissii* as figured by Stelfox (5, pl. 2). I do not know how high a degree of salinity *peregra* will live and breed in, but Miss Nicol (6, p. 178) records it living in Loch Leodasay, North Uist, in a salinity of 2·8 pro mille, and possibly more. At Greenisland, Co. Antrim, I knew it for ten years in a streamlet invaded by the sea at almost every tide (7).

Sphaerium corneum, the third molluscan inhabitant of the field-pond, has not yet colonized any of the gutters, though Boycott (1, p. 135) says that it can live in brackish water.

My thanks are due to Dr. Helen Blackler for identifying the algae, to Dr. J. W. Jackson for checking my determinations of the mollusca, to Mr. H. Stansfield for naming most of the flowering plants, and to Professor Tattersall for naming the gammarids.

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TESTACELLA SCUTULUM—METHOD OF CLEANSING.

The following extract from my field note book, October, 1932, may be of interest.

Dust accidentally sprinkled on a crawling *T. scutulum* slid off down both sides within two seconds, carried down apparently by a wash of mucus. Repeated sprinklings were at once treated in like manner. *A. ater*, *A. hortensis*, *L. flavus* and *A. sowerbyi* failed to respond to similar treatment.

Lionel E. Adams.

THE MOLLUSCA OF A NORFOLK BROAD.

By A. E. Ellis.

(*Presidential Address.*)

In order to determine the extent to which the molluscan fauna corresponds ecologically to the plant formations and communities, and to trace the steps by which an aquatic fauna is gradually replaced by terrestrial species in the successive stages of a hydrosere from the earliest to the climax phases, a study has been made of a restricted but representative area of broadland in East Norfolk. The area selected is Wheatfen Broad, Surlingham, in the Yare valley, south of the river, about six miles east of Norwich and adjacent to Rockland Broad, with which Wheatfen Broad communicates by a narrow channel. The owner of Wheatfen, Captain M. J. D. Cockle, takes a keen interest in the natural history of his estate, and extends an enthusiastic welcome to any zoologist or botanist who visits Wheatfen to study its fauna or flora. To Captain Cockle I wish to express my gratitude, not only for permission to roam at will over his property, but also for his sustained co-operation in the collection of Mollusca, his interest in which was first aroused by observing their importance in the bill of fare of various kinds of waterfowl.

A detailed survey of the plant communities at Wheatfen, together with a preliminary list of 48 species of Mollusca, has been published by E. A. Ellis (1934), followed by further notes on the natural history and a list of the Heteroptera (1940). To Mr. E. A. Ellis I owe my first introduction to Wheatfen, since when I have enjoyed the advantage of his constant collaboration, while his thorough mapping of the plant communities forms the basis for this faunistic study.

Wheatfen is particularly suitable for ecological study, for within a manageable area (150 acres) are comprised most of the plant communities characteristic of East Anglian river valleys. The open water of the original broad has been much reduced by encroachment of reed-swamp and swamp-carr, and now consists of a number of pools connected together by channels, which have to be regularly cleared to prevent their obstruction by invading swamp plants. Drainage of the surrounding marshes is effected by dykes (broad drains, some of which are navigable in a punt) and by grups (shallow ditches), which lead directly or indirectly into the pools and channels. Altogether there are about five miles of waterways at Wheatfen. The soil is fen peat, from a few inches to over five feet in depth, below which is red gravel. The chloride content of the water,

which has a normal tidal rise and fall of eight inches, is 0·1 promille, and the *p*H is 7·5 to 8·0 (E. A. Ellis, 1934, p. 422).

Besides the account of the flora of Wheatfen published by E. A. Ellis, general descriptions of the plant formations of East Anglian fens and broads are to be found in Pallis (1911) and Tansley (1939). The successive stages of the hydrosere at Wheatfen are as follows :—

1. Open Water
↓
2. Primary Reed-swamp
↓
3. *Glyceria aquatica* swamp
↓
4. Closed Reed-swamp
↙ ↘
5*a*. Swamp-carr — 5*b*. Fen
↓
6. Fen-carr
↓
7. Oak-ash Woodland

In addition, there are artificial or anthropogenic habitats, such as the raised banks which constitute the sides of the dykes and the marsh walls, the lokes or tracks through the marshes, and the garden of Captain Cockle's house. The drains are also, of course, man-made. These various types of habitat will be considered in detail.

1. Open Water.

The open waters at Wheatfen fall into two categories, natural and artificial.

I. The natural waters consist of Wheatfen Broad itself, together with various pools, such as Deep Waters, the Bays, Mystery Pool and The Pool,[1] connected with one another by channels in which the strong tidal current has brought about the accumulation in many places of thick deposits of shells. These pools and channels are in open communication with Rockland Broad by a channel navigable in a rowing boat, and with the river Yare via the Smee, the western portion of which is, however, considerably obstructed by *Glyceria aquatica.* All this area was originally part of Rockland Broad (as shown in the Ordnance Survey of 1816–21 ; see Tansley, 1939, fig. 108), but owing to the encroachment of reed-swamp and carr the open water has become greatly reduced and almost isolated from Rockland Broad.

II. The artificial waterways consist of the drains (dykes and grups), some of which are subject to tidal influence, while others

[1] See map of Wheatfen, E. A. Ellis, 1934, pl. 2.

are more or less cut off from the main drainage system and are virtually non-tidal, though flooded at very high tides.

A. *Tidal dykes*—

(*a*) Opening directly into the river Yare (e.g. the Smee and Partable Marsh dykes).

(*b*) Communicating with the pools and channels (e.g. Home Dyke, Middle Marsh Dyke).

(*c*) Similar to (*b*), but overshadowed by trees and deficient in plant life (e.g. Sluice Dyke, Carr Dyke).

B. *Non-tidal dykes*—

(*a*) Open and unshaded (e.g. Osier Carr Dyke east).

(*b*) Invaded by reed-swamp (e.g. Osier Carr Dyke west, Penguin Dyke west, Old Mill Marsh Dyke west).

(*c*) Shaded by trees and deficient in plants (e.g. the drain in Wheatfen Carr).

The dominant plant of the submerged community is hornwort (*Ceratophyllum demersum* chiefly, *C. submersum* rare),[2] which grows in great profusion, and together with duckweed renders parts of the pools and channels almost impassable by boat in late summer. At the same time the hornwort abounds in molluscan life. The pondweeds *Potamogeton pectinatus* and *P. compressus* are also abundant, while *Callitriche* and *Elodea canadensis* are frequent. Both white and yellow water-lilies (*Castalia alba* and *Nymphaea lutea*) occur in the pools and channels, while *Hydrocharis morsus-ranae* and four species of duckweed (*Lemna minor*, *L. polyrhiza*, *L. trisulca*, *L. gibba*) are abundant in many of the dykes. Bladderwort (*Utricularia neglecta*) is restricted to Osier Carr dykes east and west, in the latter being associated with *Zannichellia palustris*. Water plantain (*Alisma plantago-aquatica*) and bur-reed (*Sparganium ramosum* chiefly, also *S. neglectum* and *S. simplex*) are frequent, while reed (*Phragmites phragmites*) and *Glyceria aquatica* rapidly invade any dykes which are not regularly cleaned out. Some of the dykes and grups, as for example in and alongside Wheatfen Carr and Surlingham Wood, are overshadowed by trees and almost devoid of phanerogamic vegetation.

The Mollusca of Open Water.

I. Pools and Channels.—The only species of mollusc which appears to be confined to these waterways is *Planorbis crista*, which occurs on water-lilies and hornwort in the pools. Four other

[2] The nomenclature of the plants is that of Druce, 1928.

species, namely *Viviparus viviparus*, *Lymnaea auricularia*, *Anodonta cygnea* and *Pisidium amnicum*, are found also in the dykes opening directly into the river Yare, but nowhere else at Wheatfen. *Viviparus fasciatus*, common in the pools and channels, is not common elsewhere, and *Pisidium henslowanum*, which is only occasionally found in the dykes, is frequent in the tidal channels, and abundant and of large size in the drains near the river. On the other hand, *Valvata macrostoma*, *V. cristata*, *Planorbis vorticulus*, *P. leucostoma*, *Segmentina nitida*, *Pisidium hibernicum* and *P. personatum* do not live in the pools and channels, although dead shells of most of these species are present in the thick shell deposits which accumulate in the tidal waterways.

The Decoy is an isolated, shallow pool, situated in the midst of closed reed-swamp on Middle Marsh, covered with a dense growth of *Eleocharis palustris* and *Chara vulgaris*. Its molluscan population consists of great numbers of *Lymnaea peregra* and *L. palustris*, with lesser numbers of *Planorbis contortus*.

II. A (*a*). Dykes opening into the river Yare : these possess an admixture of the river fauna, in addition to species common to all the open water. The distinctively fluviatile element is represented by *Theodoxus fluviatilis*, *Viviparus viviparus*, *Lymnaea auricularia*, *Unio pictorum*, *Anodonta anatina*, *Pisidium amnicum*, *P. henslowanum*, and thick-shelled forms of *P. cinereum*, *P. nitidum* and *P. subtruncatum*. *L. peregra* var. *ovata* attains a large size in these dykes.

II. A (*b*). Dykes communicating with the Pools and Channels.—These drains are subject to the ebb and flow of the tide, but have no through current such as scours the channels linking up Wheatfen Broad with the other pools. Characteristically fluviatile molluscs, such as the Unionidae, *Theodoxus*, *V. viviparus*, *L. auricularia*, *P. amnicum* and *P. cinereum* var. *ponderosa*, are absent, though *P. henslowanum* occurs here and there. On the other hand, some species frequent in non-tidal dykes, such as *Valvata macrostoma* and *Planorbis leucostoma*, are also missing, while others, for instance, *Pisidium obtusale* and *Planorbis vorticulus*, are rare.

II. A (*c*). Tidal Dykes shaded by trees.—(i) Sluice Dyke, which runs along the east side of Surlingham Wood and divides it from Wheatfen Carr, is practically devoid of vegetation, while the bottom is thickly covered with dead leaves. The following species of mollusca inhabit this drain : *Bithynia leachii*, *Valvata piscinalis*, *V. cristata*, *Lymnaea peregra*, *Planorbis contortus*, *P. complanatus* (= *Segmentina complanata*), *Sphaerium corneum*, *S.* (*Musculium*) *lacustre*, *Pisidium milium*, *P. subtruncatum*, *P. nitidum* and *P. pulchellum*. (ii) Carr Dyke, which forms the north and east boundary of Wheatfen Carr, is very similar to Sluice Dyke, except that the

tidal influence is less marked, the water is covered with *Lemna minor*, and there is considerable encroachment of *Phragmites*. The Mollusca include *Bithynia tentaculata*, *Valvata piscinalis*, *V. cristata*, *Lymnaea peregra*, *Planorbis vortex*, *P. contortus*, *Sphaerium corneum*, *Pisidium milium*, *P. subtruncatum* and *P. nitidum*.

II. B (*a*). The drain on the east side of Osier Carr is selected as a typical example of a non-tidal dyke unshaded by trees, and kept clear of intrusive reed-swamp plants. As in most of the non-tidal dykes, the bottom is very peaty, which accounts for the scarcity of Lamellibranchia, but the dense growth of frogbit and hornwort provides good holding for Gastropoda. The molluscan fauna comprises the following species: *Bithynia tentaculata*, *B. leachii*, *Valvata piscinalis*, *V. cristata*, *Lymnaea palustris*, *L. peregra*, *L. stagnalis*, *Physa fontinalis*, *Planorbis planorbis*, *P. carinatus*, *P. vortex*, *P. vorticulus*, *P. albus*, *P. contortus*, *P. complanatus*, *Segmentina nitida*, *Sphaerium corneum*, *S. lacustre*, *Pisidium milium* and *P. subtruncatum*.

II. B (*b*). Three examples of similar dykes which have, however, been considerably invaded by reed-swamp plants are: (i) Osier Carr Dyke west; (ii) the drain separating Two Acre Marsh from Old Mill Marsh, the eastern end of which, formerly in open communication with the tidal channels, has been blocked for some years by the stranded wherry *Penguin*; (iii) the dyke along the west side of Old Mill Marsh.

(i) Osier Carr Dyke west, the bottom of which consists of deep peat, is densely overgrown with hornwort and bladderwort, together with common reed and bur-reed. The mollusca are few: *Bithynia tentaculata*, *Lymnaea peregra*, *L. stagnalis*, *Physa fontinalis*, *Planorbis planorbis*, *P. contortus*, *P. complanatus*, *Succinea elegans*, *Pisidium milium*, *P. obtusale* and *P. nitidum*.

(ii) Penguin Dyke west, although connected with Osier Carr Dyke by a culvert, differs from it in flora and fauna. *Phragmites* and *Glyceria aquatica* have greatly encroached, and *Hydrocharis* is abundant, with *Callitriche* and *Ceratophyllum*, but no *Utricularia*. The species of Mollusca are more numerous: *Bithynia tentaculata*, *B. leachii*, *Valvata piscinalis*, *V. macrostoma*, *V. cristata*, *Lymnaea palustris*, *L. peregra*, *Physa fontinalis*, *Ancylus lacustris*, *Planorbis planorbis*, *P. carinatus*, *P. vortex*, *P. leucostoma*, *P. albus*, *P. contortus*, *P. complanatus*, *Segmentina nitida*, *Succinea elegans* (abundant on the floating leaves of *Hydrocharis* and *Callitriche*), *Sphaerium lacustre*, *Pisidium milium*, *P. obtusale*, *P. subtruncatum*, *P. nitidum* and *P. pulchellum* (more frequent that anywhere else at Wheatfen). *Arion ater* has been seen half-submerged on *Callitriche* in the middle of this dyke.

(iii) Old Mill Marsh Dyke west is choked with hornwort and frogbit, together with *Sparganium* and many other reed-swamp plants. It is inhabited by the following Mollusca: *Bithynia tentaculata*, *B. leachii*, *Viviparus fasciatus*, *Valvata cristata*, *Lymnaea palustris*, *L. peregra*, *L. stagnalis*, *Physa fontinalis*, *Planorbis corneus* (= *Planorbarius corneus*), *P. planorbis*, *P. carinatus*, *P. vortex*, *P. vorticulus*, *P. contortus*, *P. complanatus*, *Segmentina nitida*, *Succinea elegans*, *Sphaerium corneum*, *Pisidium milium*, *P. obtusale*, *P. nitidum* and *P. hibernicum*.

II. B (*c*) An example of a non-tidal drain shaded by trees, and with little vegetation beyond *Iris pseudacorus*, is afforded by a dyke in Wheatfen Carr, which yielded the following species: *Valvata cristata*, *Lymnaea palustris*, *L. peregra*, *Planorbis vortex*, *P. leucostoma*, *P. contortus*, *Sphaerium lacustre*, *Pisidium personatum*, *P. obtusale*, *P. milium*, *P. subtruncatum*, *P. nitidum*, *Zonitoides nitidus*, *Euconulus fulvus* and *Agriolimax laevis*. The last three species were on submerged branches and logs, and appear to be almost amphibious.

There is one other piece of artificial water deserving of mention, namely "Bomb Pool", some 50 square yards in surface area and 3–5 feet deep, which was abruptly and noisily excavated one night in July, 1940, at the south end of Old Mill Marsh, close to the stranded wherry *Penguin*. Shortly afterwards *Physa fontinalis* was taken in this new pond, the subsequent colonization of which will be followed with interest.

2. Primary Reed-swamp.

Open reed-swamp, dominated by reedmace (*Typha angustifolia* chiefly, *T. latifolia* less frequent) and *Phragmites*, represents the first step in the succession from open water to carr and fen. Comparatively few other plants are present, though here and there occur :—

Epilobium hirsutum	*Scrophularia aquatica*
Peucedanum palustre	*Rumex hydrolapathum*
Galium palustre	*Carex paniculata*
Eupatorium cannabinum	*C. riparia*
Myosotis palustris	*C. acutiformis*

The Mollusca fall into two categories : (i) Relict aquatic species ; (ii) invading hygrophilous species. To the former class belong *Bithynia tentaculata* (occasional), *Valvata cristata*, *Lymnaea palustris*, *L. peregra*, *Planorbis planorbis*, *P. contortus*, *P. complanatus*, *Sphaerium corneum*, *Pisidium personatum*, *P. obtusale*, *P. milium* (rare) and *P. nitidum*. The terrestrial component is represented by *Carychium minimum*, *C. tridentatum* (rare), *Succinea elegans*,

S. pfeifferi, *S. putris*, *Vertigo antivertigo*, *V. moulinsiana*, *Punctum pygmaeum*, *Euconulus fulvus*, *Zonitoides nitidus*, *Retinella radiatula*, *Agriolimax laevis* and *A. agrestis*. All these must be able to withstand frequent and sometimes prolonged periods of flooding, though the reed stems afford means of escape.

3. Glyceria Swamp.

Open reed-swamp is succeeded by closed reed-swamp, in the early stages of which *Glyceria aquatica* is dominant, sometimes with *Phalaris arundinacea* and *Phragmites* partly or equally dominant. The following plants are common or frequent in this community [3]:

Thalictrum flavum
Ranunculus repens
R. acer
Caltha palustris
Vicia cracca
Spiraea ulmaria
Epilobium hirsutum
Lythrum salicaria
Sium erectum
Oenanthe fistulosa
Peucedanum palustre
Angelica sylvestris
Galium palustre
Valeriana sambucifolia
Lysimachia vulgaris
Eupatorium cannabinum
Calystegia sepium
Solanum dulcamara
Myosotis palustris
Scrophularia aquatica
Mentha aquatica
Scutellaria galericulata
Stachys palustris
Rumex conglomeratus
R. hydrolapathum
Polygonum hydropiper
Urtica dioica
Iris pseudacorus
Cladium mariscus
Carex paniculata
C. acutiformis
C. riparia
Poa trivialis
Festuca elatior
Equisetum palustre

Several aquatic species of Mollusca persist in *Glyceria* swamp, namely: *Valvata cristata*, *Lymnaea palustris*, *L. peregra*, *Physa fontinalis*, *Planorbis leucostoma*, *Pisidium personatum* and *P. obtusale*. Some species of occasional occurrence, such as *Bithynia tentaculata*, *Planorbis planorbis*, *P. contortus* and *Pisidium milium*, probably owe their presence in this community to flooding. The terrestrial species are much the same as in open reed-swamp, but *Lymnaea truncatula* is very abundant, while *Vallonia pulchella* and *Ashfordia granulata* are frequent. *Vallonia excentrica*, *Cochlicopa lubrica* and *Arianta arbustorum* are also present. *Vertigo antivertigo* is more common that *V. moulinsiana*, though the reverse is the case in open reed-swamp, and also in closed reed-swamp where *Glyceria* has died out. Both these species of *Vertigo* are very common in the reed-swamps of East Norfolk. *Gonyodiscus rotundatus* (= *Discus rotundatus*) and *Arion hortensis* occur amongst *Glyceria* in the south-west corner of Alder Carr Marsh, but this is an unusual habitat for these two species.

[3] For fuller details see E. A. Ellis, 1934, pp. 426–439.

4. Closed Reed-swamp.

In the later stages of reed-swamp *Glyceria aquatica* dies out, *Phragmites* becomes dominant or frequent, and the flora is more varied, the following additional species being common :—

Ranunculus sceleratus
Cardamine pratensis
Lychnis flos-cuculi
Cerastium vulgatum
Lotus uliginosus
Lathyrus palustris
Epilobium parviflorum
E. palustre
Galium uliginosum
Cirsium palustre
Valeriana dioica
Veronica beccabunga
V. anagallis-aquatica
Rhinanthus crista-galli
Lycopus europaeus
Ajuga reptans
Plantago lanceolata
Rumex acetosa
Listera ovata
Juncus subnodulosus
Carex goodenowii
Anthoxanthum odoratum
Agrostis palustris
Calamagrostis calamagrostis

The Mollusca are not very different from those of *Glyceria* swamp, except that aquatic species are less in evidence, although *Lymnaea palustris* and *Pisidium personatum* are abundant, while *Valvata macrostoma*, *V. cristata*, *Planorbis leucostoma* and *Pisidium obtusale* maintain a foothold.

5*a*. Swamp-carr.

By "swamp-carr" is meant the sallow-ash woodland which directly succeeds reed-swamp, as distinct from fen-carr, which appears to follow on from fen. The dominant tree is grey sallow (*Salix atrocinerea*), with alder (*Alnus alnus*) and ash (*Fraxinus excelsior*) frequent and oak (*Quercus robur*) rare. In addition to many species found also in reed-swamp, the varied flora of the carrs includes the following :—

Cardamine flexuosa
C. hirsuta
Evonymus europaeus
Rhamnus frangula
R. catharticus
Prunus spinosa
Rubus spp.
Rosa canina
Crataegus monogyna
Ribes nigrum
R. rubrum
Cicuta virosa
Hedera helix
Viburnum opulus
Ligustrum vulgare
Salix aurita
S. purpurea
S. triandra
Carex remota
C. hudsonii
Dryopteris thelypteris

The terrestrial Mollusca of swamp-carr are mostly reed-swamp species, with the addition of *Vertigo pygmaea*, *V. substriata*, *Vallonia costata* (rare), *Columella edentula*, *Oxychilus cellarius* (occasional), *Vitrina pellucida* and *Limax marginatus* (= *L. arborum*). The aquatic species persisting in swamp-carr are *Lymnaea palustris*, *L. peregra*, *Planorbis leucostoma*, *P. contortus*, *Sphaerium corneum*, *Pisidium*

personatum and *P. obtusale*. The occurrence of *V. costata* in swamp-carr and in fen-carr is unexpected, as this species is normally an inhabitant of dry situations in the open, yet at Wheatfen it may sometimes be found on the same log as such damp-loving molluscs as *Zonitoides nitidus*, *Agriolimax laevis* and *Carychium minimum*.

5*b*. Fen.

The characteristic plant of fen is the rush *Juncus subnodulosus*, with the following plants frequent :—

Thalictrum flavum
Ranunculus repens
R. acer
R. flammula
Caltha palustris
Cardamine pratensis
Lychnis flos-cuculi
Trifolium pratense
Lotus uliginosus
Vicia cracca
Potentilla erecta
Epilobium parviflorum
E. palustre
Hydrocotyle vulgaris
Oenanthe lachenalii
Angelica sylvestris
Peucedanum palustre
Galium uliginosum
G. palustre
Valeriana dioica
Scabiosa succisa
Eupatorium cannabinum
Cirsium palustre
Centaurea obscura
C. nemoralis
Taraxacum sp.
Menyanthes trifoliata
Rhinanthus crista-galli
Mentha aquatica
Prunella vulgaris
Plantago lanceolata
Rumex acetosa
Listera ovata
Orchis praetermissa
O. maculata
Iris pseudacorus
Carex paniculata
C. goodenowii
Agrostis palustris
Holcus lanatus
Dactylis glomerata
Briza media
Equisetum palustre
Ophioglossum vulgatum
Cladium mariscus (locally frequent)

The few aquatic species of Mollusca occurring in fen probably owe their presence there to periodic flooding, and their survival to their ability to remain inactive amongst damp moss and humus for considerable periods. Such species are *Valvata cristata*, *Lymnaea palustris*, *Planorbis leucostoma*, *P. contortus* and *Pisidium personatum*, all of which are frequent. Terrestrial molluscs are represented by *Vertigo substriata*, *V. pygmaea*, *Lauria cylindracea*, *Arion intermedius*, *A. ater*, *Trichia hispida*, *Cepaea nemoralis*, *Retinella nitidula*, *Oxychilus alliarius*, *O. cellarius* and *Vitrea crystallina*, in addition to species occurring also in reed-swamp. *Ashfordia granulata* is particularly abundant, while *Arion ater* and *Agriolimax agrestis* are very common in fen. These three species, together with *Succinea putris* and *C. nemoralis*, are most in evidence when the fen is flooded at high tides, the water sometimes reaching a depth of 12 to 18 inches. On these occasions the snails and slugs ascend the stems of rushes and other tall-growing plants, and may be seen

in hundreds, in company with beetles, spiders and other small refugees, like shipwrecked mariners clinging to the masts. It is at such times that the abundance of animal life on the marshes can be best appreciated.

In parts of Thack Marsh *Myrica gale* is abundant, indicating lower alkalinity; this marsh is moreover poorly drained. The molluscan fauna of Thack Marsh is comparatively meagre, both in number of species and of individuals, the species noted being *Carychium minimum*, *Lymnaea palustris*, *Succinea putris*, *Vertigo moulinsiana*, *V. substriata*, *Punctum pygmaeum*, *Ashfordia granulata*, *Euconulus fulvus*, *Zonitoides nitidus*, *Retinella radiatula*, *Agriolimax laevis* and *A. agrestis*.

6. Fen-carr.

Wheatfen Carr is a compact area of advanced fen-carr adjacent to Surlingham Wood, from which it is separated by Sluice Dyke. Pedunculate oak and ash are the dominant trees, with alder, hazel, grey sallow, privet, elder, guelder rose, dog rose, bramble, red and black currants, honeysuckle, hawthorn, ivy, sycamore, buckthorn and spindle all frequent. Aspen, poplar (*Populus serotina*), birch and sloe are less frequent. The herbaceous flora includes :—

Ranunculus ficaria
Viola riviniana
Arenaria trinervia
Geranium robertianum
Geum urbanum
Spiraea ulmaria
Fragaria vesca
Potentilla anserina
Circaea lutetiana
Bryonia dioica
Galium aparine
Arctium minus
Eupatorium cannabinum
Lapsana communis
Primula vulgaris
Ajuga reptans
Urtica dioica
Tamus communis
Iris pseudacorus
Arum maculatum
Phragmites phragmites
Brachypodium sylvaticum
Dryopteris filix-mas
D. aristata

The dampness of the low-lying ground, most of which is liable to be flooded at spring tides, favours the persistence of hygrophilous species, such as *Lymnaea palustris*, *Succinea putris*, *Vertigo moulinsiana*, *Arianta arbustorum* and *Zonitoides nitidus*, which are not found in the neighbouring wood. The following species are common to both fen and fen-carr, but are absent from reed-swamp and swamp-carr : *Lauria cylindracea* (abundant), *Arion ater*, *Trichia hispida*, *Cepaea nemoralis*, *Retinella nitidula* and *Oxychilus alliarius*. The slugs *Arion circumscriptus* and *A. hortensis* occur in Wheatfen Carr, although absent from the preceding habitats, except for the casual occurrence of the latter species in a small patch of *Glyceria aquatica* on Alder Carr Marsh.

7. Oak-ash Woodland.

Surlingham Wood, which occupies the south-west corner of the Wheatfen estate, may be regarded as the climax of the ecological prisere: open water → primary reed-swamp → closed reed-swamp → fen → fen-carr → oak-ash woodland. The richness of the molluscan fauna indicates that this is natural, old-established woodland, for the most part little affected by planting. Tuck's Plantation, which adjoins Surlingham Wood on the south side, supports a considerably less varied fauna. The wood is situated on slightly higher ground than the Carr, and thus escapes the flooding to which the latter is liable, though here and there wet hollows and shallow drains or grups provide a habitat for *Pisidium personatum* and *P. obtusale.* Of the trees, oak, ash and hazel predominate, while *Salix* is absent. The field layer is more varied than that of the Carr, the following additional plants being frequent:

Anemone nemorosa
Sisymbrium alliaria
Lychnis dioica
Potentilla sterilis
Ribes uva-crispa
Sanicula europaea
Chaerefolium sylvestre
Nepeta hederacea
Prunella vulgaris
Teucrium scorodonia
Euphorbia amygdaloides
Scilla non-scripta
Juncus effusus

Nine species of fern are also represented.

With the exception of an occasional example of one or other of the two species of *Pisidium* mentioned above, the molluscan fauna of Surlingham Wood is composed exclusively of terrestrial species. Several hygrophilous species which live in Wheatfen Carr are absent from the wood. On the other hand, *Acanthinula aculeata* and *Clausilia rugosa* (= *C. bidentata*), both characteristic woodland snails, have been found nowhere else at Wheatfen. The xerophilous *Helicella heripensis* (= *H. gigaxii*) lives on the bank which forms the western boundary of Surlingham Wood and the southern border of Tuck's Plantation, and even penetrates for a short distance into the wooded area.

8. Artificial Habitats.

I. Raised banks.—The embankments thrown up in the process of constructing the dykes, the marsh " walls ", and the causeways or lokes across the marshes, provide a suitable habitat for some of the less moisture-loving species. *Trichia striolata* is recorded by E. A. Ellis (1934, p. 447) from the marsh banks, though I have not seen it at Wheatfen. *Ena obscura* occurs in the hedge along Drive Loke, and *Limax maximus* at the western end of Smee Loke;

neither species has been found in the wood, where they might be expected to occur.

II. Garden.—The garden species are relics or immigrants from the adjacent fen and wood, with the exception of *Helix aspersa*, which is confined to the garden and to the border of a cultivated field adjoining Tuck's Plantation. The slugs, particularly *Agriolimax reticulatus* and *Arion hortensis*, flourish like the wicked and the green bay-tree, while other species maintain a rather more precarious footing. As the table indicates, many species native to Wheatfen are unable to tolerate cultivation of the soil, though they may abound within a few yards of the garden plot.

Notes on Individual Species.

Unio pictorum : lives only in drains, such as the Smee and the dykes along the north and south sides of Partable Marsh, which communicate directly with the river Yare. Although *U. pictorum* inhabits Rockland Broad, with which Wheatfen Broad was formerly continuous, it has now disappeared from the pools and channels of Wheatfen, where the only Unionid is *Anodonta cygnea.*

Anodonta anatina : this species belongs to the river fauna, but penetrates some distance up the dykes opening into the Yare, where it is more frequent than its congener. In East Norfolk *A. anatina* is definitely a river mussel, and I have not seen any specimens from the broads, where *A. cygnea* is often abundant. This may be due, not to any preference for rivers as such, but to the avoidance by *A. anatina* of habitats where there is a thick deposit of mud, as suggested by Bloomer (1930, p. 14).

Pisidium : a thick-shelled form of *P. cinereum*, referable to var. *ponderosa* Stelfox, lives in the river Yare and in the dykes draining into the river. Elsewhere in the Wheatfen waters *P. cinereum* is absent or very local ; E. A. Ellis (1934, p. 448) records it from the pools and channels, but I have not detected this species there myself. It is possible that a large form of *P. subtruncatum*, which is not uncommon in the pools, may have been confused with *P. cinereum*, but the specimens collected by Mr. E. A. Ellis have been lost. Both *P. subtruncatum* and *P. nitidum* are very common at Wheatfen. The finest specimens of the former are from the pools and channels ; in the dykes opening into the river some of the specimens are of the thickened form similar to that figured by Stelfox (1918, pl. 7, figs. 1–4). *P. henslowanum* is abundant and of large size in the dykes draining into the river ; in the tidal dykes and channels it is less frequent, and is apparently absent from the

non-tidal drains. *P. hibernicum*, on the other hand, is rare, and has only been found in some of the non-tidal dykes. *P. personatum* is very common in reed-swamp, and rather frequent in some of the shallow drains, but does not occur in the deeper waters.

Theodoxus fluviatilis : a straggler from the river, found only at the mouth of the Smee and Partable Marsh dykes.

Viviparus : *V. viviparus* is the commoner of the two species in the dykes by the river, and is fairly frequent in the tidal channels. *V. fasciatus*, while occurring with its congener in these habitats, lives also in the tidal dykes draining into the pools and channels, and in some of the non-tidal drains, where it is not common. *Planorbis corneus* is practically identical with *V. fasciatus* in habitat, and *Lymnaea auricularia* with *V. viviparus*.

Valvata : *V. piscinalis* occurs in all open waters, except in some of the very poor drains in the shade of trees. It is particularly abundant in the dykes opening into the river and in the tidal channels, attaining a large size in the former. In general its requirements are fairly similar to those of *Bithynia tentaculata*, *B. leachii*, *Lymnaea stagnalis*, *Planorbis carinatus* and *P. albus*. *V. macrostoma* is fairly frequent in the non-tidal dykes, and occurs also in shallow drains or grups, and occasionally with *Pisidium personatum* in reed-swamp. The dead shells of *V. macrostoma* are abundant in the tidal channels, but the living animal appears to be restricted to water where there is little or no current. *V. cristata* lives in all the dykes and also in reed-swamp and fen. It thrives in poor habitats, which it usually shares with *Planorbis contortus*.

Carychium : Germain's statement (1931, p. 559) to the effect that *C. tridentatum* lives in quite different stations from *C. minimum* and is not palustral is not entirely true for Wheatfen, where both species sometimes occur together, even in reed-swamp, swamp-carr and fen. *C. minimum* is, however, by far the more common species in wet places, being especially abundant amongst *Glyceria aquatica*, while in the drier parts of Wheatfen Carr and Surlingham Wood, and on raised banks, *C. tridentatum* occurs to the exclusion of its congener.

Lymnaea : *L. truncatula* does not make its appearance until *Glyceria* swamp is reached, and is absent from open water and primary reed-swamp. In *Glyceria* swamp it is *the* characteristic species, and is present in myriads. It occurs also in closed reed-swamp, swamp-carr and fen in decreasing numbers. Boycott (1936, p. 143) is certainly right, as he nearly always is, when he says: "I do not reckon it as a water species." *L. palustris* has the widest range of habitat of any member of the genus, occurring in all formations from open water to fen-carr. It is

abundant but of small size in reed-swamp, and attains its largest growth in the well-stocked drainage dykes. This species is the most completely amphibious of our freshwater snails, being apparently equally at home in or out of water. I have observed it laying its eggs on damp soil in reed-swamp. The Wheatfen specimens of *L. peregra* would be called *L. ovata* or *L. limosa* by Continental conchologists; the question of the specific distinctness of these forms requires further investigation, and in the meantime it seems preferable to retain the more familiar name for our commonest freshwater snail.

Planorbis: *P. planorbis* occurs in all types of open water, except the overshadowed drains deficient in plant life, and is present also in open reed-swamp. *P. complanatus* has somewhat similar requirements, but is more tolerant of bad habitats. *P. carinatus* is commonly found with these two species, but is not so abundant as *P. planorbis*, and is absent from reed-swamp, though it persists in dykes in which reed has been allowed to encroach. *P. crista* has only been found in the pools and channels, associated with *P. carinatus*, *P. albus* and *P. complanatus*. *P. vortex* is frequent in all open water, but, though more catholic in its requirements than most other members of the genus, does not persist in reed-swamp. *P. leucostoma*, which survives in all stages of reed-swamp and fen, is absent from the pools, channels and tidal dykes, and rare in the non-tidal drains, except the poor ones, where it is common. *P. vorticulus* lives in dykes rich in vegetation, especially *Hydrocharis*, where many other species of Mollusca are also present, and is absent from the pools and channels and also from the drains shunned by other species. It is a capricious snail, and may be abundant in one dyke, and absent from a neighbouring drain where conditions would appear to be equally favourable. Though dead shells of *P. vorticulus* are frequent in the thick shell deposits of the tidal channels, the species does not live there. *Segmentina nitida* has a somewhat similar distribution, but is less eclectic in its choice of habitat and occurs in most of the dykes, except those completely devoid of vegetation; it is especially abundant in drains choked with *Glyceria*.

Succinea: of the three species occurring at Wheatfen, *S. elegans* is the most moisture-loving and *S. putris* the most terrestrial. *S. elegans* is found only close to water, and is particularly fond of crawling on the floating leaves of *Hydrocharis* and *Callitriche*, though it frequently ascends the stems and leaves of *Phragmites*, *Glyceria*, *Rumex hydrolapathum* and other tall plants growing in or beside the dykes, pools and channels. This species is not uncommon in the marshes of the Yare valley, and has been found

also in the Bure valley (Upton) and by the canalized river Ant near North Walsham. The distinctive characters of this and the other British species of *Succinea* have been described by Quick (1933).

Lauria cylindracea : abundant in Wheatfen Carr and in the damper parts of Surlingham Wood, besides occurring in fen and swamp-carr. This species was recorded by E. A. Ellis (1934, p. 447) as *Pupilla muscorum*, which is not known to occur at Wheatfen, though recorded from the neighbouring parish of Bramerton (Mayfield, 1909, p. 797).

Gonyodiscus rotundatus : very local at Wheatfen, occurring here and there in the wood, on the marsh banks, and in one patch of *Glyceria aquatica* on Alder Carr Marsh. It is abundant in a nettle patch at the north-west corner of Old Mill Marsh, in association with hygrophilous species such as *Arianta arbustorum*, *Zonitoides nitidus*, *Succinea putris* and *Agriolimax laevis*.

Euconulus fulvus : this little snail, together with *Agriolimax laevis*, is present in all habitats except open water, and is even found on submerged logs in the marsh drains. *Retinella radiatula* is almost equally ubiquitous.

Agriolimax "agrestis" : while this paper was in proof, information was received from Mr. Hugh Watson that examples of *Agriolimax* from Wheatfen which had been submitted to him represent two species : (1) *A. reticulatus* (Müll.), which is the common slug hitherto called "*A. agrestis*" by British authors ; (2) *A. agrestis* (L.), of which he writes : "These are the first adult British examples of *A. agrestis* (L.) that I have dissected. I have seen what I think are young ones from Scotland, but hitherto all the pale English specimens that I have looked into have proved to belong to the light-coloured variety of the common *A. reticulatus*." In the table which follows "*A. agrestis*" must accordingly be regarded as a composite of two species, the respective habitats of which have not yet been exactly determined. Pending further research, it can be stated that at Wheatfen true *agrestis* occurs in damp situations, being abundant in fen which is frequently flooded, while *reticulatus* occupies drier habitats, such as raised banks and the garden.

Summary.

The habitats of the 85 species of Mollusca found at Wheatfen are summarized in the accompanying table. A dotted line signifies an abnormal habitat, or one in which the species in question occasionally occurs. An asterisk (*) indicates species which live also in the river Yare ; in addition, *Hydrobia jenkinsi*

(*teste* E. A. Ellis), *Ancylastrum fluviatile* (Mayfield, 1909, p. 800), and *Myxas glutinosa* have been found in the Yare, but not at Wheatfen. The nomenclature of the Gastropoda is that of A. E. Ellis (1926); a few emendations, suggested by Mr. Hugh Watson, are added in parentheses in the text. For comparison the Mollusca of three other similar areas are included, namely:—

(1) Wicken Fen, Cambridgeshire: list compiled from Brindley (1925), Oldham (1926), and A. E. Ellis (1931). In addition to the species indicated in the table, *Aplexa hypnorum* and *Theba cantiana* (= *Monacha cantiana*) also occur at Wicken, making a total of 53 species from this locality. *T. cantiana*, though not observed at Wheatfen, has been found at Surlingham by E. A. Ellis, while *A. hypnorum* is recorded from ditches by the Yare at Thorpe (Mayfield, 1909, p. 804).

(2) Upton Broad and marshes, in the Bure valley, East Norfolk, where 56 species of Mollusca have been observed. For permission to visit Upton Broad I am indebted to Mr. B. B. Riviere, F.R.C.S.

(3) Alderfen Broad, Neatishead, in the valley of the river Ant, East Norfolk (the property of the Norfolk Naturalists' Trust). This locality yielded 40 species of Molluscs.

The faunistic survey of both Upton and Alderfen was much less thorough than that of Wheatfen, and it is probable that further search would add to the list of species from these areas. In view of its abundance at Wheatfen, the absence of *Ashfordia granulata* from these other three localities is remarkable. Other species "conspicuous by their absence" from Upton and Alderfen are *Lymnaea truncatula*, *Arianta arbustorum* and *Vallonia pulchella*, all very common at Wheatfen. The broads at Upton and at Alderfen are separated by a distance of a mile or more from their parent rivers, which accounts for the absence of some fluviatile species, such as *Unio pictorum*, *Anodonta anatina*, *Viviparus viviparus*, etc.

The distribution of the terrestrial Mollusca at Wheatfen is governed chiefly by the water level, and as this is also the principal factor in determining the plant formations, there is bound to be some correlation between the two, although few species are restricted to any one type of habitat. While it is in general true, as pointed out by Boycott (1934, p. 34), that molluscs do not exhibit any specific association with any particular plant communities, nevertheless it is possible to speak of characteristic fen molluscs, reed-swamp molluscs, etc. Each plant formation, such as reed-swamp, swamp-carr, fen, fen-carr and oak-ash woodland, has its distinctive molluscan community, although many species overlap and are common to several different habitats. There are also stragglers which find their way into places where the species does not normally

Alderfen Broad	Upton Broad	Wicken Fen	Mollusca of Wheatfen Broad, Surlingham, East Norfolk	1 Dykes by R. Yare	2 Pools and Channels	3 Tidal Dykes	4 Non-tidal Dykes	5 Shaded Drains	6 Open Reed-swamp	7 Glyceria Swamp	8 Closed Reed-swamp	9 Swamp-carr	10 Fen	11 Fen-carr	12 Oak-ash Woodland	13 Banks	14 Garden
			**Unio pictorum*	—													
			**Anodonta anatina*	—													
			**Theodoxus fluviatilis*	—													
	U	W	**Pisidium cinereum*	—													
A	U	W	**Anodonta cygnea*	—	—												
		W	**Pisidium amnicum*	—	—												
			**Viviparus viviparus*	—	—												
	U	W	**Lymnaea auricularia*	—	—												
		W	**Pisidium henslowanum*	—	—	—											
	U	W	**Viviparus fasciatus*	—	—	—	—										
A	U	W	**Planorbis corneus*	—	—	—	—										
A	U	W	**Lymnaea stagnalis*	—	—	—	—										
A	U	W	**Ancylus lacustris*	—	—	—	—										
A	U	W	**Planorbis carinatus*	—	—	—	—										
A	U	W	**Planorbis albus*	—	—	—	—										
		W	**Pisidium pulchellum*	—	—	—	—	—									
A	U	W	**Pisidium subtruncatum*	—	—	—	—	—									
A	U		*Sphaerium lacustre*	—	—	—	—	—									
A	U	W	**Bithynia tentaculata*	—	—	—	—	—	.....	.....							
A	U	W	**Bithynia leachii*	—	—	—	—	—									
A	U	W	**Valvata piscinalis*	—	—	—	—	—									
A	U	W	**Planorbis vortex*	—	—	—	—	—									
A	U	W	**Planorbis planorbis*	—	—	—	—		—	.....							
A	U	W	*Planorbis complanatus*	—	—	—	—	—	—								
A	U	W	**Pisidium nitidum*	—	—	—	—	—	—								
A	U	W	**Pisidium milium*	—	—	—	—	—	—	.....							
A	U	W	**Sphaerium corneum*	—	—	—	—	—	—			—					
A	U	W	**Lymnaea peregra*	—	—	—	—	—	—	—		—					
A	U	W	**Physa fontinalis*	—	—	—	—		—	—							
	U	W	**Pisidium obtusale*	—	—	—	—	—	—	—	—	—			.....		
A	U	W	**Planorbis contortus*	—	—	—	—	—	—	—		—	—				
A	U	W	**Valvata cristata*	—	—	—	—	—	—	—	—		—				
A	U	W	**Lymnaea palustris*	—	—	—	—	—	—	—	—	—	—	—			
A		W	*Planorbis crista*		—												
	U		*Planorbis vorticulus*			—	—										
	U		*Segmentina nitida*			—	—										
		W	*Pisidium hibernicum*				—										
		W	*Valvata macrostoma*				—				—						
	U		*Planorbis leucostoma*				—	—	—	—	—		—				
	U		*Succinea elegans*				—		—	—			—				
A	U		*Pisidium personatum*					—	—	—	—	—	—	.....	.....		
A	U	W	*Zonitoides nitidus*					.....	—	—	—	—	—	—		—	
A	U	W	*Euconulus fulvus*					.....	—	—	—	—	—	—	—	—	—
A	U	W	*Agriolimax laevis*					.....	—	—	—	—	—	—	—	—	—
A	U	W	*Succinea pfeifferi*						—	—	—	—	—				
	U	W	*Vertigo antivertigo*						—	—	—	—	—				
A	U	W	*Vertigo moulinsiana*						—	—	—	—	—	—			
A	U	W	*Carychium minimum*						—	—	—	—	—	—	—		
	U	W	*Punctum pygmaeum*						—	—	—	—	—	—	—		

Alderfen Broad	Upton Broad	Wicken Fen	Mollusca of Wheatfen Broad, Surlingham, East Norfolk	1 Dykes by R. Yare	2 Pools and Channels	3 Tidal Dykes	4 Non-tidal Dykes	5 Shaded Drains	6 Open Reed-swamp	7 Glyceria Swamp	8 Closed Reed-swamp	9 Swamp-carr	10 Fen	11 Fen-carr	12 Oak-ash Woodland	13 Banks	14 Garden
	U	W	*Succinea putris*						—	—	—	—	—	—		—	.....
	U		*Carychium tridentatum*						—	—		—	—	—	—	—	
A	U	W	*Retinella radiatula*						—	—	—	—	—	—	—	—	—
A	U	W	*Agriolimax "agrestis"*						—	—	—	—	—	—	—	—	—
		W	*Lymnaea truncatula*							—	—	—	—				
		W	*Vallonia pulchella*							—	—	—	—				
			Ashfordia granulata							—	—	—	—	—	—	—	
		W	*Arianta arbustorum*							—	—	—	—	—		—	—
A	U	W	*Cochlicopa lubrica*							—	—	—	—	—	—	—	—
			Vallonia excentrica							—		—					
			Vertigo substriata									—	—				
	U		*Columella edentula*									—		—	—		
	U		*Vitrina pellucida*									—		—	—	—	
			Limax marginatus									—		—	—	—	
		W	*Vertigo pygmaea*									—	—	—		—	
A	U	W	*Arion intermedius*									—	—	—	—	—	
A	U		*Vitrea crystallina*									—	—	—	—	—	—
	U		*Lauria cylindracea*										—	—	—	—	
A	U		*Oxychilus alliarius*										—	—	—	—	
A	U	W	*Arion ater*				.....						—	—	—	—	—
A	U	W	*Trichia hispida*										—	—	—	—	—
A	U	W	*Cepaea nemoralis*										—	—	—	—	—
	U		*Retinella nitidula*										—	—	—	—	—
	U		*Oxychilus cellarius*									.....	—	—	—	—	—
			Vallonia costata									.....		—		—	
	U		*Arion hortensis*							.....				—	—	—	—
A			*Arion circumscriptus*											—	—	—	—
			Acanthinula aculeata												—		
			Clausilia rugosa												—		
			Gonyodiscus rotundatus							.....			.....		—	—	
			Helicella heripensis												.....	—	
			Ena obscura													—	
			Trichia striolata													—	
			Limax maximus													—	
			Helix aspersa													—	—

live: for example, *Helicella heripensis* in the outskirts of the wood, *Arion ater* in the middle of a dyke, *Gonyodiscus rotundatus* in *Glyceria* swamp. Some molluscs, while not restricted to any particular species of plant, yet exhibit a noticeable preference for definite types of vegetation. *Limax marginatus*, at Wheatfen as elsewhere, is found amongst trees, though not necessarily on them. *Vertigo moulinsiana* and *V. antivertigo* are usually to be seen on *Glyceria aquatica* and on some of the larger sedges, such as *Cladium*,

Carex paniculata, *C. acutiformis* and *C. riparia*, where they are sure to be found if they are present in the locality. *Succinea elegans* occurs in great numbers on *Hydrocharis*, and if I wished to collect *Lymnaea truncatula* or *Carychium minimum* in bulk I should go to *Glyceria* swamp.

The habitats of aquatic molluscs, within the restricted area under consideration, are not easy to define. A few species are restricted to the immediate neighbourhood of the river, from which they are immigrants; others find their optimum habitat in the pools, channels and larger drainage dykes; while a few seem to prefer bad places shunned by most molluscs. At Wheatfen the most important factors regulating the occurrence of Mollusca in any particular aquatic habitat appear to be: (1) Shade; (2) Current; (3) Nature of the bottom; (4) Depth.

(1) Shade: the growth of water plants is inhibited by overshadowing trees, or dense growth of reeds, and this results in a reduction in the oxygen content of the water. Accumulation of decaying leaves also has a deleterious effect. Few molluscs can tolerate such conditions.

(2) Current: some species are absent from channels or dykes where there is a strong tidal current; others, while present in flowing water, are more abundant in still water, or where there is a tidal ebb and flow but no through current. The best habitats at Wheatfen are the wide, shallow drains, rich in vegetation, with no through current. *Planorbis vorticulus*, one of the most fastidious of water snails, is restricted to such places. As these drains are artificial, one is left to speculate as to the original natural habitat of such species; presumably an undrained marsh would have numerous shallow pools which would provide the ecological equivalent of drainage ditches.

(3) Nature of the bottom: this chiefly concerns the bivalves; where there is a deep accumulation of peat, Lamellibranchia are scarce or absent, and they also tend to avoid a stony or gravelly bottom, where the tide has scoured away the peat. Unionidae are restricted to the pools and channels, and to the tidal dykes closely connected with the river. *Theodoxus fluviatilis*, which is confined to the outlet of the riverside dykes, requires stones for a foothold, and the only other place at Wheatfen where it might be expected to live (but does not) is the old ford at the western end of Middle Marsh.

(4) Depth: the central, deeper parts of the pools are relatively poor in molluscan life, and most species prefer shallow water; this preference is not confined to pulmonates. The broads are never so rich in molluscs as the surrounding dykes.

Conclusion.

At first sight a broad, with its communicating drains and channels, and a level stretch of marshland might appear to constitute two fairly homogeneous types of environment, but on investigation each is revealed as an intricate mosaic of diverse habitats. In this paper an attempt has been made to give a bare outline of one aspect of this checkered pattern. Many problems have been suggested and left unsolved. I hope, however, that I have been able to convey some idea of the wealth and variety of molluscan life in a still wild and unspoilt district of England.

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AN UNDESCRIBED LAND SHELL FROM S.W. AFRICA.

By M. Connolly.

While my recent "Monographic Survey of South African Non-Marine Mollusca" (*Ann. S.A. Mus.*, xxxiii, 1939) was in course of production and after the plates were completed ready for publication, it became necessary, owing to the receipt of some fresh anatomical material, to postpone dealing with the genus *Xerocerastus* and its allies and to relegate them to a Supplement to follow after the appearance of the main portion of the work. The result is that on plate ix there is figured a quaint little species, new to science, unaccompanied by any description to validate its name. This omission is remedied in the present paper.

Xerocerastus ovulum sp.n.

1939. *Xerocerastus ovulum* Conn., *Ann. S.A. Mus.*, xxxiii, 1939, p. 656, pl. ix, f. 21, 22. F., (*sine* descr.)

Shell small, acuminate ovate, perforated, dull, fairly smooth, cream with streaks and patches of fawn and infrequent small dark dots; lower half of protoconch also fawn-coloured. Spire not greatly produced, sides sub-gradate, slightly convex, apex bluntly rounded. Whorls 6, convex, regularly increasing; first $2\frac{1}{2}$ bearing a few extremely fine, prominent microspiral threads, 6 visible on 3rd whorl of type at end of protoconch; remainder irregularly sculptured with fine, close, nearly vertical striae, cut up into oblong granules by spiral grooves, more or less in continuation of the apical threads; suture simple, impressed. Aperture $\frac{3}{4}$-circular, peristome white, glossy, slightly thickened; labrum straight and erect in profile, columella erect, concave, margin rather broadly reflexed in front of the narrow umbilicus.

Alt. 6·6, lat. 4·1; apert. alt. 2·7, lat. 2·2; last whorl 4·75 mm.

Hab. NAMIB. Between Aschieb and Cape Cross (N. J. G. Smith).

Type in Albany Museum, Grahamstown.

The number of spiral threads at end of protoconch varies from 4 to 6 on the 9 specimens examined, which differ slightly also in size and contour, some being about 7 mm. in length and one practically 5 mm. in breadth. The epiphragm is unusually thick, without apparent vent-hole.

This species is related to *X. hottentotus* (Gray) but is much smaller. The anatomy of these forms, as well as their apical sculpture, suggests that they may possibly need to be placed in another genus than *Xerocerastus*; it is hoped, however, to deal with this in the Supplement to my work.

RHIOSTOMA MACALPINE-WOODSI LAIDLAW.

By F. F. Laidlaw.

By the courtesy of Mr. Tomlin I have been able to examine a specimen of *Rhiostoma macalpine-woodsi* Laidlaw [1] in which the operculum has been retained.

In describing the species I noted that it and its near ally *jousseaumei* de Morgan differed from other species referred to *Rhiostoma* in shell characters as well as in size, and I expected that the operculum would give some further character which could be used to differentiate these two from other *Rhiostoma*.

The two "sections" Pterocyclaceae and Cyclotaceae of the family Cyclophoridae, both exuberantly represented in Tropical Asia and in the neighbouring islands, are based at present on the characters of the operculum, and it is often impossible to tell from shell characters only whether a given species is to be put in a genus belonging to one or the other section.

The operculum of the first of these sections, the *Pterocyclaceae*, is often dome-shaped, in some species almost thimble-like, with a spiral sculpture on the outer side which has the outer margin of the spire frilled and projecting, giving the operculum a very characteristic look. Further the operculum is often horny and not calcified, though in some species, e.g. of *Rhiostoma*, calcification is present.

On the other hand, the *Cyclotaceae* have a flat, calcified operculum which looks like two circular discs stuck together at their middles, the outer one with a spiral sculpture which never has a free margin, but with each coil lying flush with the preceding and following coils. In both sections the spiral has a small slightly depressed nucleus.

With this preface I can say that the operculum does not show any grounds for removing *macalpine-woodsi* (and presumably *jousseaumei*) from *Rhiostoma*.

[1] See this *Journal*, vol. xxi, p. 166.

THE TAXONOMY OF NAIADES INHABITING A LAKE ENVIRONMENT.

By Henry van der Schalie.

(*Read before the Society, 2nd February,* 1940.)

As our knowledge concerning the ecology and distribution of certain groups of animals increases it becomes necessary in the light of this information to evaluate some of the nomenclature that has come into general use. Many attempts at classification have resulted in artificial arrangements. Revisions are then needed to correct these to a more natural system. This need is especially paramount in certain groups. With this problem in mind the following considerations are given regarding the taxonomy of lake-inhabiting Naiades.

It has been known for some time that mussels living in a lake environment often tend to become dwarfed or stunted. As early as 1834, Isaac Lea named *Symphynota benedictensis* which we now recognize as a lake form of *Anodonta grandis*. A few years later DeKay (1843) applied the name *rosaceus* to the stunted lake form of *Lampsilis siliquoidea*. Both species are common in the small inland lakes of the glaciated portions of the upper Mississippi and St. Lawrence drainages. It is not surprising, therefore, that these lake-forms were early named. On the other hand, the larger lakes such as Chautauqua Lake, New York, Lake Erie, and Lake Winnebago, Wisconsin, which harbour an unusually great number of naiad species, were not carefully investigated till comparatively recent time. Not until the twentieth century did the application of special names to lake forms become a common procedure, and as a result most species displaying lake-inhabiting characteristics were named by present-day conchologists.

Lake Erie, particularly the west end, is remarkable for its rich naiad fauna. No other lake anywhere harbours so many species of mussels. Consequently, this lake is the type locality for several lake-forms. Walker (1898, 1913) has shown that this abundance is directly the result of a post-glacial invasion into Lake Erie of Mississippi mussels when a connection existed between the waters of the St. Lawrence and Mississippi drainages by way of the Maumee River outlet. With a mussel fauna of approximately thirty species and a variety of ecological conditions the western portion of Lake Erie affords good opportunities for studies on the response of Naiades to different ecological factors.

Brown, Clark, and Gleissner (1938) made commendable use of the facilities available in western Lake Erie to investigate the causes of

dwarfing among lake-dwelling mussels. Their studies conclusively show that the degree of stunting in mussels is directly correlated with the degree of exposure to which Naiades are subjected in their normal habitat. It is not necessary to review their work here, but on the basis of what is now known concerning the environmental effect of shoal exposure on mussels in lakes, it is advisable that some reference be made to the taxonomic implications involved in the naming of ecological forms. An examination of the validity of current taxonomy is desirable for several reasons : (1) It enables us better to appreciate difficulties when dealing with intergrading forms ; (2) it may give an evaluation of the significance or insignificance of some names now in use ; and (3) it may simplify matters for those who are not taxonomists but who are interested in proper designations in the use of many names now applied to intergrading forms.

Some of the more common environmental forms of Naiades accredited to Lake Erie and other large lakes are as follows :—

1. *Fusconaia flava parvula* Grier. This form was named by Grier in 1918. That *parvula* was merely an ecological form was recognized long before Grier named it. Whether or not its configuration warrants subspecific status is open to question, particularly in the light of what is now known of the variation of this species within Lake Erie.

2. *Quadrula pustulosa prasina* (Conrad). Ortmann and Walker (1922, 16) join *schoolcraftensis* and *prasina*. The *prasina* form is recognized by Ortmann (1919) and F. C. Baker (1928) as the form found in Lake Erie.

3. *Quadrula quadrula* (Raf.). No form has been named, although actually a form is recognized. Ortmann (1919, 43) wrote : " Sterki says that the Lake Erie form is ' little inflated and has few tubercles '."

4. *Amblema costata plicata* (Say). Ortmann and Walker (1922, 13) gave specific rank to this *form*. F. C. Baker (1928, 79–80) admits that *plicata* is a lake *form* but suggests that it should be written as though it were a distinct species.

5. *Cyclonaias tuberculata* (Raf.). A special form name has not been applied to specimens from Lake Erie, although actually there are specimens available which show a high degree of stunting. To be consistent a special name should apply here as well.

6. *Pleurobema cordatum pauperculum* (Simpson). This is the same as variety *magnalacustris* of Simpson (1914, 884). Ortmann (1919, 84) states : " I have not seen any specimens grading toward the parent-form, and for this reason we might perhaps be justified in regarding this as a true species." However, Ortmann clearly did not wish to make the necessary change because of a lack of sufficient

material. From what we now know concerning the variation of other species of Naiades in Lake Erie there is every reason to believe that intergrading specimens do exist.

7. *Elliptio dilatatus sterkii* Grier. Although Grier described this as a distinct variety Brown, Clark, and Gleissner (1938, 689) have shown that: "According to height, all of our specimens (those from the river as well as the lake) belong to the stream variety while according to obesity they would all become *sterkii*. We seriously doubt the validity of varieties based upon such characters."

8. *Anodonta grandis footiana* (Lea). Certain conditions in lakes give rise to the *footiana* form of *grandis*. Although Ortmann (1919, 148) was inclined to consider *footiana* as a geographical race of *grandis*, he indicated that both *footiana* and *benedictensis* were "distinctly dependent on ecological conditions", and that they were connected by intergrades. Recent studies reveal that similar conditions anywhere will produce similar forms among Naiades so that the concept of geographical races in the *grandis* group is untenable.

9. *Anodonta imbecillis fusca* F. C. Baker. This dwarfed form of *imbecillis* according to Baker represents an ecological variety, and is reported by him from the open shore of Sturgeon Bay, Wisconsin. He (1927, 222) writes: "It appears to be a dwarfed form of *imbecillis* produced, probably, by its habitat in a turbulent bay . . ." Similar forms appear under similar circumstances in western Lake Erie and elsewhere.

10. *Anodontoides ferussacianus buchanensis* (Lea). That *buchanensis* is an ecological form is clearly indicated by Ortmann (1919, 170–171) in his discussion of this form in Lake Erie. Of considerable interest in this connection is a supposed new species of *Anodontoides* named *birgei* by F. C. Baker (1923, 123). Baker (1928, 182) states that *birgei* is a form produced by a lake environment and adds: "It is possible that the *buchanensis* listed by Ortmann as living in Lake Erie may readily be a form of *birgei*." This procedure of naming ecological forms and even elevating them to the rank of good species is quite illustrative of the dangers which attend a taxonomy that fails to take into account intergrading forms.

11. *Strophitus rugosus rhombicus* (Anthony). Although the name *rhombicus* is not generally applied to the Lake Erie form, F. C. Baker (1922, 132) states that Anthony's *rhombica* "appears to fit this form and renders a new name unnecessary". The variation of this species has been discussed by van der Schalie (1938, 58) and it is suggested that the range of variation in *rugosus* is so great that it is not expedient to refer extremes of variation to subspecific categories which have been artificially erected.

12. *Alasmidonta calceolus magnalacustris* F. C. Baker. The matter of naming the lake form of this species has been discussed (van der Schalie, 1938, 58–59). As in the case of other ecological forms it becomes impracticable to apply names to extremes of variation, even though it is of interest to observe that such variations are correlated with the environment.

13. *Lasmigona costata eriganensis* Grier. This ecological form was named as a distinct variety by Grier (1918, 10). Its validity as a subspecies is doubtful because it will most likely prove as unwise to recognize this variety as it is to accept *Elliptio dilatatus sterkii* and *Fusconaia flava parvula*, which were named simultaneously.

14. *Lasmigona complanata katherinae* (Lea). Specimens of *complanata* have not been found in Lake Erie, but they are reported from Lake Huron by Goodrich and van der Schalie (1932, 9). However, this species has been reported from the Huron River (van der Schalie, 1938, 54–55) making it highly probable that the lake form, *katherinae*, may occur in Lake Erie. Obviously this form is produced in exposed conditions of lake environment and might well be considered with other forms similarly produced.

15. *Ptychobranchus fasciolaris lacustris* F. C. Baker. It is generally known that a stunted lake form of this species occurs in Lake Erie. Ortmann (1919, 210) did not think " it advisable to distinguish the lake-form by a varietal name, but the tendency to develop a local race is clearly indicated in this case ". Nevertheless, F. C. Baker (1928*a*, 52) suggested that a special name should be applied. But Brown, Clark, and Gleissner (1938, 690), in their study of the variation of *fasciolaris* in Lake Erie, conclude : " It seems to us that varieties named on the basis of size variation alone have no significance in this species."

16. *Obliquaria reflexa* Rafinesque. Although Ortmann (1919, 215) stated : " There is a dwarf race in Lake Erie, light in colour, which possibly deserves a varietal name," no one has as yet applied a special name to this form.

17. *Proptera alata* (Say). Since Lake Erie is the type locality of this species, a form name cannot be applied to distinguish the lake-form. Ortmann (1919, 255) called attention to this condition, and suggested that the form from rivers should be known as *Proptera alata megaptera*, if a nomenclatorial distinction between the forms of this species is to be made. The variation demonstrated by Brown, Clark, and Gleissner (1938), in their study of *alata* in Lake Erie, clearly shows that it is not feasible to name these ecological forms.

18. *Leptodea fragilis lacustris* F. C. Baker. The marked variation of *fragilis* in Lake Erie is strikingly shown by Brown, Clark, and

Gleissner (1938, 693). Ortmann (1919, 249) also recognized this fact and consequently did not feel that a name should be applied to the extremes of variation within *fragilis*.

19. *Obovaria leibii* (Lea). It has long been known that *leibii* is merely the lake form of *O. subrotunda*. Ortmann (1919, 225) clearly stated this: "Another 'species' distinguished by Lea (and Simpson), *O. leibii*, is nothing but the form from Lake Erie of *O. subrotunda*."

20. *Ligumia nasuta* (Say). Ortmann (1919, 275) states: "There is not much variability in *E. nasuta*." However, Brown, Clark, and Gleissner (1938, 694) have shown that this species becomes definitely stunted much as other species of mussels do upon exposure. In the Huron River (a tributary of Lake Erie) two specimens were reported as river-mouth inhabitants by van der Schalie (1938, 64). Their size indicates that this species reacts to river conditions in a way similar to *Ligumia recta latissima*, the river form of *Ligumia recta*. The following measurements are given to indicate the comparatively large size of the two river-inhabiting *nasuta* taken from the mouth of the Huron River in Michigan :—

Number of Specimens.	*Annulae.*	*Length in mm.*	*Height in mm.*	*Diameter in mm.*	*Obesity.*	*Locality.*
1	13	115	44	36·5	·317	Huron River, Flat Rock.
1	12	114	48	36·5	·320	Huron River, E. of Willow.

None of the specimens reported by Ortmann (1919) or by Brown and others (1938) are as large as those reported here.

21. *Ligumia recta* (Lamarck). Since the stunted lake-form *recta* was originally described from Lake Erie, as pointed out by Ortmann (1919, 279), the name *recta* is retained for the lake form. *L. recta latissima* is then generally applied to the form inhabiting rivers. Brown, Clark, and Gleissner (1938, 695) state: "Grier (1920) gives the Lake Erie form the varietal name of *latissima* but fails to show as great a difference between the lake and stream form as we found within the lake itself."

22. *Micromya iris novi-eboraci* (Lea). This variety is considered to be (Ortmann, 1919, 270) the form common to Lake Erie. However, the distinction is made on the basis of colour pattern, which in specimens from the Huron River (van der Schalie, 1938, 63) was found to be an unreliable criterion in the separation of *iris* and *novi-eboraci*. As for size, *iris* becomes stunted in a lake environment but this has never been emphasized by the application of a special name.

23. *Lampsilis siliquoidea rosacea* (DeKay). Some of the best evidence indicating a marked response of mussels to their environment is found among specimens of *siliquoidea*. Ortmann (1919, 291), van der Schalie (1938, 68–9) and others have stressed the complete intergradation between the stunted lake-form, *rosacea* and normal *siliquoidea*. However, Brown, Clark, and Gleissner (1938, 697) in comparing size differences conclusively show that: "It is doubtful whether these differences have significance taxonomically, since the variation within Lake Erie itself is greater than the difference between lake and stream forms." These results cast considerable doubt on the validity of such subspecies as *pepinensis* and *chadwicki* described by F. C. Baker (1927, 223, and 1928, 279).

24. *Lampsilis ventricosa canadensis* (Lea). The relationship of *canadensis* to *ventricosa* is much the same as that of *rosacea* to *siliquoidea*. Brown, Clark, and Gleissner (1938, 699) have shown a direct correlation between the degree of stunting and the amount of exposure within portions of western Lake Erie. When this is taken into account there is little reason for accepting such names as *lurida* Simpson (1914, 41), *perglobosa* F. C. Baker (1928, 285), or *winnebagoensis* F. C. Baker (1928, 291).

25. *Truncilla truncata lacustris* F. C. Baker. Specimens of *truncata* from Lake Erie are definitely stunted. F. C. Baker (1928, 228) suggests that these forms may also be referred to *lacustris*. The variation of *truncata* within Lake Erie is large enough to make it unreasonable to apply special names to the lake forms.

26. *Truncilla donaciformis* (Lea). Although *donaciformis* in Lake Erie is usually smaller than *truncata*, it also tends to become noticeably stunted in a lake environment. It is indeed surprising that F. C. Baker named a lake form of *truncata* but failed to suggest a special name for the lake form of *donaciformis*. Yet Baker (1928, 231) states: "The same relative variation recorded under *truncata* also occurs in *donaciformis*." This is inconsistent, or is it possible that those who would advocate naming ecological forms are not themselves too convinced that it is wise to do so?

27. *Dysnomia triquetra* (Raf.). Stunted forms of *triquetra* are found in Lake Erie. There is some indication that Walker (1913, 21) considered the name *triangularis* as applicable to this form. But later the use of *triangularis* was discontinued. The relative scarcity of *triquetra* in lakes may account for the failure to apply a special name to the dwarfed lake form.

28. *Dysnomia perplexa rangiana* (Lea). Considerable doubt exists regarding the taxonomic status of *perplexa* and *torulosa*, but whether *rangiana* belongs with one or the other is not of immediate importance here. In either case *rangiana* represents the dwarfed lake form

and it shows much the same response to exposure as has been observed in other Naiades.

A SUMMARY OF THE ENVIRONMENTAL FORMS OF NAIADES INHABITING LARGER LAKES IN U.S.A.

	Name.	*Type Locality.*	*Date.*
1.	*Fusconaia flava parvula* Grier	Lake Erie	1918
2.	*Quadrula pustulosa prasina* (Conrad)	Fox River, at Green Bay	1834
3.	*Quadrula quadrula* (Rafinesque)	Ohio River	1820
4.	*Amblema costata plicata* (Say)	Lake Erie	1817
5.	*Cyclonaias tuberculata* (Rafinesque)	Ohio River	1820
6.	*Pleurobema cordatum pauperculum* (Simp.)	Niagara Falls	1900
7.	*Elliptio dilatatus sterkii* Grier	Lake Erie	1918
8.	*Anodonta grandis footiana* (Lea)	Lake Winnebago	1840
9.	*Anodonta imbecillis fusca* F. C. Baker	Sturgeon Bay, Wisc.	1927
10.	*Anodontoides fer. buchanensis* (Lea)	Buck Creek, Ohio	1838
11.	*Strophitus rugosus rhombicus* (Anthony)	Michigan	1865
12.	*Alasmidonta calceolus magnalacustris* (F. C. Baker)	Sturgeon Bay, Wisc.	1928
13.	*Lasmigona costata eriganensis* Grier	Lake Erie	1918
14.	*Lasmigona complanata katherinae* (Lea)	Lake Superior (*erroneous*)	1838
15.	*Ptychobranchus fasciolaris lacustris* F. C. Baker	Chautauqua Lake, N.Y.	1928
16.	*Obliquaria reflexa* Rafinesque	Kentucky River	1820
17.	*Proptera alata* (Say)	Lake Erie	1817
18.	*Leptodea fragilis lacustris* (F.C.Baker)	Lake Butte des Morts	1922
19.	*Obovaria leibii* (Lea)	Erie County, Michigan	1862
20.	*Ligumia nasuta* (Say)	Delaware and Schuylkill Rivers	1817
21.	*Ligumia recta* (Lamarck)	Lake Erie	1819
22.	*Micromya iris novi-eboraci* (Lea)	Oak Orchard Creek, N.Y.	1838
23.	*Lampsilis siliquoidea rosacea* (DeKay)	Seneca Lake, N.Y.	1843
24.	*Lampsilis ventricosa canadensis* (Lea)	St. Lawrence River	1857
25.	*Truncilla truncata lacustris* F. C. Baker	Lake Winnebago	1928
26.	*Truncilla donaciformis* (Lea)	Ohio	1828
27.	*Dysnomia triquetra* (Rafinesque)	Falls of the Ohio	1820
28.	*Dysnomia perplexa rangiana* (Lea)	Ohio River	1839

In the preceding discussion an effort has been made to show that most mussels inhabiting a lake environment develop stunted forms to which varietal names have usually been applied. If dwarfing were restricted to Lake Erie there would perhaps be occasion to designate the stunted forms as geographic races. But the studies of Brown, Clark, and Gleissner, Ortmann, Grier, F. C. Baker, van der Schalie and others, covering many lakes and streams, reveal that similar ecological forms are produced by similar ecological conditions. It is obvious that unless some endeavour is made to indicate definitely the difference between ecological forms and subspecies an undue amount of confusion will persist in our

taxonomy. If for any reason whatsoever one wishes to designate a form it would be more sensible to do so as follows : *Lampsilis siliquoidea* form *rosacea.* A rule of this sort would eliminate the misleading emphasis which is placed on forms when they are written as a subspecific or even as a specific name.

Other experiments and studies along the lines of testing the effect of ecological factors on mussel characteristics will undoubtedly aid the taxonomist. Such studies as these should be encouraged. A few attempts have been made in mussel transplantation, but these were not successful. Although the evidence at hand would indicate that dwarfing among Naiades is entirely phenotypic, recourse to experimental evidence is desirable to prove that it is not genotypic.

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PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN & IRELAND.

(*Continued from p. 218*)

Ross, W. (105). *S. pfeifferi* (F. Booth).
Ross, E. (106). *S. pfeifferi* (D. K. K.).
Sutherland, E. (107). *S. pfeifferi* (J. R. le B. T.).
Sutherland, W. (108). *S. pfeifferi* (C. O.).
Caithness (109). *S. pfeifferi* (C. O.).
Hebrides (110). *Bathyomphalus contortus*, *Arianta arbustorum*, *Clausilia cravenensis* Tarbet, Harris and N. Uist (G. H. Harrison), *Zonitoides excavatus*, *Sphaerium corneum* (K. B. B.), *S. pfeifferi* (A. R. W.).
Orkney (111). *S. pfeifferi* (A. W. S.).
Shetland (112). *S. pfeifferi* (C. O.).
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Down (115). *S. pfeifferi* (D. K. K.).
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Donegal, W. (119 W). *S. pfeifferi* (A. W. S.).
Fermanagh (120). *S. oblonga* (J. R. le B. T.).
Meath (123). *S. putris* (D. K. K.), *S. pfeifferi* (A. W. S.), *S. oblonga* (P. H. Grierson).
Dublin (124). *Pisidium lilljeborgi* (Miss Lillis), *Agriolimax laevis* (A. W. S.).
Kildare (125). *S. putris*, *S. pfeifferi* (D. K. K.), *Agriolimax laevis* (A. W. S.).
Queens Co. (130). *S. putris* (D. K. K.), *S. pfeifferi* (C. O.), *S. arenaria* (C. O. and R. A. Phillips).
Leitrim (135). *Vertigo lilljeborgi* (A. W. S.).
Mayo, W. (138). *S. pfeifferi* (C. O.).
Galway, S.E. (140 S). *S. pfeifferi* (R. A. P.).
Limerick (142). *S. putris* (D. K. K.).
Tipperary, N. (143). *S. arenaria* (R. A. P.).
Cork, M. (146 M). *Punctum pygmaeum*, *S. putris*, *Milax sowerbyi*, *M. gagates*, *Potamopyrgus jenkinsi* (W. E. R. Hackett per A. E. E.).
Cork, W. (147). *Vertigo lilljeborgi* (A. W. S.), *V. angustior*, *H. virgata* (W. E. R. H. per A. E. E.), *S. oblonga* (C. O., A. E. B. and A. R. W.).
Kerry, N. (148 N). *S. putris* (A. R. W.).
Kerry, S. (148 S). *S. putris* (A. R. W.), *S. pfeifferi* (A. W. S.).

MARINE RECORDER'S REPORT.

Dr. Jackson has sent lists from Manchester Museum, chiefly from the Kidson Taylor and Darbishire collections.

The list for Mulroy Bay, Co. Donegal (Darbishire), contained many smaller species, e.g. *Odostomia unidentata* (Montagu), *Brachystomia eulimoides* Hanley, *Partulida spiralis* (Montagu), *O. turrita* Hanley, *Eulimella laevis* (Brown), *Evalea divisa* (J. Adams), *Pyrgisculus rufescens* (Forbes), *Parthenina obtusa* (Brown), *Cyclostrema nitens* Ph.

Owing to my having resumed work at Bradfield College, and undertaken certain other work it has been impossible to investigate the lists as fully as I should have wished and to see some of the species. This I hope to do later.

Mrs. Morehouse has again been of great assistance. From Mull and the mainland she sent a list of over fifty species. I had no records of many of these for Mull and I think that a few of them are new for Area XII. This is sure to be so in the case of several Nudibranchs. Her list for Calgary Bay included *Janthina britannica* (Forbes & Hanley).

Mr. W. Fowler has done much work in the Tenby and Falmouth districts. He has established the existence of *Lepidopleurus scabridus* (Jeff.) at Falmouth

and Tenby. He has also sent a large number of preserved *Berthella*, some of which are *plumula* (Montagu) while others will, I hope, prove to be the new species *Berthella engeli*; also *Acanthochitona discrepans* (Brown) from Tenby and Milford Haven, and a rather abnormal form of *Loripes lucinalis leucoma* (Turton) from Helford.

Other good things taken alive by Fowler at Falmouth are *Manzonia crassa* (Kanmacher), *Lepidopleurus cancellatus* (Sowerby), *Odostomia turrita* Hanley and *Triphora perversa* (Linné). He remarks that *L. scabridus* was found " nearly at extreme low tide under stones as big as a coal scuttle and covered with a rust-like deposit ".

Mr. W. F. Lloyd James has been collecting *Nucella lapillus* (Linné) in West Wales : he also mentions *Donax vittatus* (da Costa), *Mactra corallina cinerea* Montagu, *Macoma balthica* (Linné), *Chamelea striatula* (da Costa), *Gari depressa* (Pennant), *Osilinus lineatus* (da Costa), and *Clathrus clathrus* (Linné).

Mr. G. C. Spence has sent in a further list for Port Patrick, Galloway.

In North Cornwall (Polzeath) *Onchidella celtica* (Forbes & Hanley) occurred in very large numbers, and *Lamellaria perspicua* L. occurred in large rock pools.

Erato voluta (Montagu) and *Mangelia rugulosa derelicta* Reeve seem to occur no longer at Trebetherick, where I used to find them in some numbers years ago.

CURATOR'S REPORT.

DURING the past twelve months many sets of shells have been placed in glass-topped boxes. The Oldham collection of British Land and Fresh Water Shells has been readjusted and slightly rearranged. A list of the contents of the cabinet has been made and is almost ready for the catalogue to be typed out in entirety. All work at the collections has been suspended for the present.

YORKSHIRE CONCHOLOGICAL SOCIETY.
ANNUAL REPORT 1939.

THE officers for 1939 are :—

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Seven indoor meetings have taken place since the last Annual Meeting, with an average attendance per meeting of 10·3 persons. The Joint Meetings with the Conchological Society in November and April were each attended by thirteen members.

The January meeting was devoted to General Exhibits and five members showed a varied selection of fossil, land, freshwater, and marine forms. Several lantern slides were shown by Mr. Thurgood.

In February a meeting, attended by nine members, was for the purpose of exhibiting Freshwater Mollusca. Five members showed series of these Mollusca and considerable discussion took place.

The Presidential Address was delivered in March. The subject was " Some Thoughts on Classification ", and Members were most kindly entertained to tea after the meeting by the President and Mrs. Fisher.

The excursions have been to Boston Spa, Nostel, and Kippax. There

are still two meetings to complete the year's programme. In November there will be a Joint Meeting at Leeds and a lecture will be given by Mr. C. Allen in December.

Membership now stands at 21.

E. DEARING,
Hon. Secretary.

ANNUAL REPORT OF THE LONDON BRANCH 1938-9.

NINE meetings have been held, Mr. A. S. Kennard again occupying the chair. A varied syllabus, which contained such items as Land Shells of Sicily, Land Shells of Corsica, British *Ancylus*, Sex in Mollusca, *Turbinella* and *Busycon* and Asian Streptaxinae has been worked through successfully. Exhibits have been good throughout the session, particularly at the May meeting when fine series of *Amphidromus* were shown.

The members have been greatly indebted to the President and Lt.-Col. Peile for notes on the various items down for discussion ; also to Mr. J. E. Cooper for continuing to send his notes on the Marine Genera.

No arrangements have been made for future meetings but it is hoped that these may be resumed at a not too distant date.

GUY L. WILKINS,
Hon. Secretary.

662nd Meeting (Extraordinary Meeting) held at the British Museum (Nat. Hist.), London, S.W. 7, on 24th November, 1939.

The President (Mr. A. E. Ellis) in the chair.

Election of New Members.

W. E. R. Hackett, Miss E. A. Bush, W. G. Geakings, J. H. Clarke, J. M. R. M. Viader, John Wharton, P. O. Barnett.

HYDROBIA JENKINSI SMITH ON BEACHY HEAD

The finding of *H. jenkinsi* in a large cement cattle trough early in 1936 was recorded in this *Journal*, vol. xx, p. 290. The trough got its water from a pond some 100 yards distant. Both pond and trough held *Sphaerium lacustre* and *L. peregra*. No *H. jenkinsi* had been taken in the pond during the three years previous to its turning up in the trough, or subsequently up to October, 1936. The pond and trough were visited again in June, 1939, after a lapse of nearly three years. The trough had been cleaned out, and apparently a new water supply laid on ; the pond water probably got too dirty for the cattle. The trough was free from mud, and the water perfectly clear. *S. lacustre* and *H. jenkinsi* had disappeared, but a fair number of adult *L. peregra* was present, larger than any previously taken, possibly due to the elimination of *H. jenkinsi* and many of the *L. peregra* from the somewhat limited food area. The pond was found to be in a very foul condition, very little water, much mud (road drainage), slime, and confervae. There was a small bed of weed in the middle, possibly *Potamogeton*, but so covered with mud that the species was doubtful.

No living *L. peregra* could be found (the droughts of 1937 and 1938 may have killed them), but a few young *S. lacustre* were taken. *H. jenkinsi* was in abundance. Its disappearance from the trough can be accounted for by the cleaning, but it is remarkable that it now abounds in the pond. Though specially looked for in this pond on a number of occasions, it was never taken there up to October, 1936.

It is worthy of note how rapidly *H. jenkinsi* increases in numbers after it once appears. It was so in Friston Pond and in the trough (see vol. xx, p. 136).

G. SHRUBSOLE.

Malacological Society of London.

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ECOLOGICAL NOTES.

By A. E. Ellis.

(*Read before the Society, 15th February,* 1941)

Trichia subvirescens (Bellamy).—The occurrence of this snail on Babbacombe cliffs (limestone), South Devon, is worth placing on record, in view of Boycott's statement (1934, p. 33) that there is no evidence for its having been found living in calcareous places. Incidentally, Boycott gives the British distribution of this species as " coastal grass from Ilfracombe to Plymouth ", although there are records of its occurrence at several places east of Plymouth, e.g. Kingsbridge, Torcross, Brixham, Torquay, Dawlish and Axminster (Taylor, vol. 4, p. 45).

Oxychilus lucidus (Drap.) and **Milax sowerbii** (Fér.).—Neither of these species is habitually sylvestral, but both are numerous in a wooded dell at Thorpe St. Andrew, near Norwich. Within recent years the estate in which this wood is situated has been " developed " as building land, and it is probable that these molluscs have been introduced from neighbouring gardens, but they are now quite at home in their wild habitat.

O. lucidus is now frequent in gardens in the neighbourhood of Norwich, though it does not appear to have been recorded from East Norfolk until 1931.[1]

Myxas glutinosa (Müller).—Boycott (1936, p. 143) states that this species " lives chiefly in draining ditches and canals, also in slow rivers and some shallow Irish lakes ". The inference is that it is usually absent from swiftly flowing streams. In the river Yare at Old Lakenham, near Norwich, *M. glutinosa* occurs not only in comparatively still water away from the main current, but also in the fordable, fairly rapidly flowing part of the stream where there is a stony bottom. It is to be seen crawling on the mud in quieter parts of the river, and on stones and on objects such as bones at the ford. Adults are to be found in April, but by September only very young individuals are present, thus confirming the suggestion that " its reputation for vagariously appearing and disappearing is probably due to the adults breeding early in the summer and then dying off so that only infants are present during the usual holiday season ". Cooper (1931) states that in Chislet marshes, Kent, the adults are dying off by mid-June, having bred towards the end of May. By the end of September some of the next generation " appeared to be mature ". *M. glutinosa* has previously been

[1] *J. Conchol.* **19**, 185.

recorded from the river Yare, or its immediate vicinity, at Colney and Keswick (Mayfield 1909, p. 800).

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HELICELLA CAPERATA MONT. IN SUSSEX.

By Arthur G. Stubbs.

(*Read before the Society, 2nd February,* 1940.)

Last autumn I came across a variety of the above species that is new to me. About two dozen specimens were taken from a piece of waste ground surrounding a new building estate bordering the Old Shoreham Road, at Southwick.

It has the pure white ground colour of the var. *obliterata*, but any bands, or markings, are of a pale orange pink, strong near the mouth and becoming paler and translucent up the spire. I found three forms corresponding in marking to the type, var. *ornata* and var. *radiata* of the ordinary *H. caperata*. When containing the animals, the shells look like dead and bleached specimens, but on being cleaned the shells show up pearly white with rosy markings.

This variety seems to be analogous to a variety of *H. virgata* from the cliffs near Rottingdean, which has also the pure white ground-colour, and orange-pink translucent markings, and the same weathered look when containing the animal. At Woodingdean on the Downs I have taken specimens of a beautiful variety of *Helix aspersa*. Pale yellow ground-colour as in the var. *exalbida*, but with pinkish translucent bands and markings accentuated near the mouth. These three forms of *H. caperata*, *H. virgata*, and *H. aspersa* appear to me to be an intermediate stage between the normal and albinism.

LIST OF THE BRITISH NON-MARINE MOLLUSCA.

By A. S. Kennard, A.L.S., F.G.S.

(*Read before the Society, 14th March*, 1941.)

Introduction.

It is now thirty-eight years since a list of the British non-marine mollusca was issued by the Society and many subsequent changes have passed into common use. There are others which are less well known, so I have considered it advisable to compile a list embodying these changes. Such a list consists of facts and opinions. The facts are that certain mollusca occur, but the specific names they should bear, the names of the genera in which they should be placed and their systematic arrangement are matters of personal opinion. On legal points judges are known to differ and honest differences of opinion can easily arise in interpreting the International Rules of Zoological Nomenclature. The following list therefore contains the names which in my opinion should be used, though in some cases deference has been paid to the opinions of the many friends who have kindly assisted me.

With regard to divisional names the requirements of members must be studied. A perusal of the Journal revealed that genus and species were practically the only two used and after all they were all that Linné recognized. They are all that are required by biologists, ecologists, field naturalists, palaeontologists, and collectors who have always been the backbone of our Society and whose decrease we all deplore.

On tabulating the divisional names which have been proposed for the British species it was found that far more names had been proposed than there were species, which is absurd. It has therefore been considered advisable to reduce the divisional names to Class, Order, Family, and Genus. In the arrangement the well-known work of Thiele has been followed. The genotype has been given in each case (G.T.). It is obvious that all the genera here used are not of equal value though I have adopted them in deference to the opinions of friends, but no harm would be done to science if they were reduced, especially in the *Helicidae*. One can appreciate the viewpoint of those people who have often said to me, "Why don't you call them all *Helix* then we should know what you mean?" Certain it is that a simple classification will attract students whereas an elaborate one will repel them. There were far more students of mollusca when a very simple classification was in use than there are to-day.

As to specific names preference has been given to those based on

British examples for obvious reasons. Many of the Linnean specific names can be challenged on the ground that they were originally aggregates but they have been revised by subsequent workers and are now traditionally fixed. The dates when the species and genera were described have been given so far as can be ascertained, but it is probable that some are too early, for the date on a title-page or preface is too often not the date of issue.

With regard to varietal names the few included are true subspecies. Enthusiasm has outrun discretion and far too many names have been given, and to straighten out varietal nomenclature is a hopeless task owing to inadequate descriptions, absence of measurements, and lack of authentic specimens.

If, however, anyone wishes to use varietal names, and I certainly have no objection to their use, there are the works of Jeffreys and Taylor, and though the names used may be invalid no harm will arise provided that due care is taken, for everyone will know what form is meant. It should be stressed that it is better to use English varietal names than earlier continental ones presumed to be identical, and to give measurements where size is in question instead of the vague var. *major* or var. *minor*. It is the fashion to deprecate varietal names, but it may be pointed out that *Planorbis acronicus* Fér. and *Clausilia dubia* Drap. (vera) were placed on the British list through the use of varietal names.

The better known name in square brackets has been given in some cases.

The letter H prefixed to a species indicates that it is known from Holocene deposits but is not known living, with the hope that it may yet be found in a living state. It is unlikely, however, that *Unio auricularia* Spengler still lives in England for it has also apparently died out in Northern France and Germany.

The list is in three sections :—

1. Indigenous species and those that have been introduced but are now well established. *Helix aspersa* Müller was certainly intentionally colonized over the greater part of England in Roman times as an article of food.

2. Introduced species. They are ten in number and have been accidentally introduced and have managed to exist for varying periods under more or less natural conditions. The wonder is that more species are not introduced. Thousands of young *Helix aperta* Born have arrived in this country with flowers from Italy and France yet no case of colonization has been reported. Those species of which only dead examples or a single specimen have been found are ignored.

3. Greenhouse Aliens. This comprises most of the species that have been introduced with plants and maintain a precarious existence under artificial conditions. Their occurrence is of no scientific value though it is of interest. The use of *Cochlicella decollata* (Linné) calls for extended notice. This species is always considered the type of *Rumina* Risso 1826, but in 1829 Dr. D. Thon selected it as the type of *Cochlicella* Férussac 1821 and this selection is valid. (Ersche and Grube, *Allgem. Encyc. Wissensch. Kunste*, Sect. 2, Vol. 5, p. 138, Art. Helix.) In spite of the vast amount of anatomical research on the slugs a decade or more ago we are now assured that there are far more species: until these species are clearly demonstrated the old names may well stand.

In every case the spelling of a name is as originally proposed by its author.

It is interesting but of no real importance to know the name of the person who suggested a specific or generic name or whose MS. name was adopted by the real author, but it is obviously out of place in a list. The authors' names cited are those who validated the name by publication, not only by proposal but also in synonymy.

Notes on Some of the Names

Viviparus.—There has been considerable discussion on the Continent as to the correct names of the two species. Linné's types, bearing his script, are in the Linnean Collection and these show that the English use of *viviparus* for the smaller species is correct. For the larger species the use of *fasciatus* (Müll.) is suggested. Unfortunately German authorities reverse the names and this must be remembered. Should *fasciatus* (Müll.) prove to be a synonym of *viviparus* (Linné) the correct name for the larger species will be *cristallinus* (Gray) 1821, which is based on English material, since *contectus* (Millet) 1813 is said to be a form of *viviparus* (Linné).

Potamopyrgus jenkinsi (Smith).—Since this species occurs in a Romano-British deposit at Bath its identity with *crystallina* (Pfr.) is more than doubtful and the late Professor Gwatkin maintained that the radulae were different. It is more scientific to continue the use of the well-known name.

Bythinella steinii (Mart.).—It is with regret that this should be used for *Paludestrina taylori* Smith. This is not a recent introduction since it occurs in the Pleistocene of Cambridgeshire and in the Holocene of the Thames and Eastern England.

Bithynia Leach.—The continued use of this name instead of *Bulimus* Scopoli is urged for it is clear that all the facts were not

submitted to the Commission and their decision was against the evidence.

Carychium Müller.—The two species recognized on the Continent have been considered valid. It is to be hoped that our esteemed member, Hugh Watson, will shortly publish the results of his anatomical work on the two forms.

Planorbis leucostoma Millet.—After an examination of a large series both recent and fossil it has been concluded that *P. leucostoma* Mill., *P. spirorbis* (Linné) Auct., and *P. septemgyratus* Rossm. are one species, the differences between them being probably due to environment. There is strong evidence for the view that *spirorbis* (Linné) is identical with *albus* Müll. Hence it is better to use *leucostoma* Mill. of whose identity there can be no doubt.

Truncatellina brittanica Pilsbry.—On *a priori* grounds it is doubtful if there are two species of this genus in the British Isles ; hence it is better to use the name based on British specimens.

Zua lubrica (Müller).—Since under Art. 28 *Cochlicopa* Férussac 1821 is not available it is necessary to use another generic name and the choice is between *Cionella* Jeffreys 1830 and *Zua* Turton 1831 (in synonymy). The type of *Zua* is *lubrica* (Müll.) whilst the type of *Cionella* has never been fixed so far as can be traced. The combination *Zua lubrica* was in common use in the last century whereas *Cionella* at the same time was used for species of *Achatinidae*. Hence preference should be given to *Zua*. *Cionella acicula* Müller is now nominated as the type of *Cionella* and it thus becomes a synonym of *Cecilioides* Férussac 1814.

Vertigo concinna Scott.—This edentulous species may yet be found living. It was fairly common in the early Holocene of Hertfordshire, Lincolnshire, Northamptonshire, King's Co., Ireland, as well as at Kirkland Leven, Fifeshire, the type locality showing that it was a widely spread species.

Clausilia suttoni Westerlund.—It has been shown that this is the correct name for the shells formerly called *cravenensis* Taylor, and that it is distinct from *dubia* Drap. The isolated colony of *dubia* (vera) at Dover Castle was probably an introduction with building material from Normandy.

Testacella.—The statement that *Testacella haliotoides* Lamarck 1801 is a *nomen nudum* has recently been repeated. This is at variance with the facts.

Lamarck in his *Systeme*, p. 96, gave a full description of the genus and the name cited. There are many such cases in early literature and it has been decided that the description of the genus covers that of the species : see opinion 43. This is a just decision

for a description of the species would be simply a repetition of the generic description. The statement that Lamarck cited in synonymy Favanne's figures is incorrect. Lamarck as a rule cited the synonyms without comment, but in this and a few other cases he says "voyez". Apparently Lamarck was not certain that Favanne's figures represented his species. Férussac admitted that *maugei* was identical with the earlier *haliotoides* Lamarck. No harm would arise if the use of *maugei* Fér. 1819 were continued until it has been definitely shown that the Teneriffe species is identical with the English form, for *maugei* was described from Bristol specimens.

Gonyodiscus ruderatus (Hart.).—This species was apparently widely distributed in Holocene times, being known from Essex, Nottinghamshire, and Lincolnshire where it was fairly common. It is not improbable that it may still be living in the north-west of England.

Retinella petronella (L. Pfeiffer) is a recent addition to our indigenous species which we owe to the enthusiasm of our veteran member, J. F. Musham, F.R.E.S., and though it is only known from the early Holocene of Lincolnshire where it is not uncommon, this species may still be lingering on.

Oxychilus rogersi (B. B. Woodward).—This specific name has been preferred to the earlier *helvetica* (Blum). Judging from the shells I have seen named *helvetica* by well-known Continental authorities it was an aggregate species including *draparnaldi* (Beck).

Helicidae.—In this family the conclusions of anatomists have been accepted and there are thus sixteen genera for twenty-three species. Had a wider view of what constitutes a genus been taken and the points of agreement stressed instead of the differences matters would be different. If one were not a splitter and one had only the shells to judge from, the six Xerophiles would be placed in *Trochoidea*, the eight species now separated in *Monacha*, *Zenobiella*, *Hygromia*, and *Trochulus* would be united in *Trochulus* and the remaining seven genera adopted. After all, when a shell is well developed, its characters are quite as important as those of the radulae or the genitalia. All three must be considered and not one alone.

Planatella Clessin.—Since the type of *Helicella* Férussac 1821 cannot be *itala* (Linné) *Planatella* is used instead being the next available name.

Longaeva Menke.—Since the type of *Cochlicella* Férussac is *Helix decollata* Linné it is necessary to find a new generic home for *Helix acuta* Müller, and apparently *Longaeva* Menke 1830 is the correct choice. The name is apparently M.S. of Megerle von Muehlfeld and first appears in synonymy in Menke (*Synop. Moll.*,

p. 15, 1828), with a ? note, but in the second edition, p. 27, 1830, the query is omitted. Should this be a printer's error then *Elisma* Turton 1831 also in synonymy will be the correct generic name.

Trochulus as the generic name for *hispidus* (Linné) is of Férussac 1821 (*Prodrome Limaçons*, p. 48, in synonymy). The *hispidus* complex still awaits a satisfactory solution. Two species are listed *hispidus* (Linné) and *libertus* (West.). The latter is certainly not an ecotype. *Hispidus* Linné does vary greatly according to environment from the small form of the chalk hills, var. *nana* Jeff., to the large flat form of the river meadows, var. *concinna* Jeff.

Helicodonta Férussac is used for *obvoluta* (Müller). According to Article 28 of the International Code this name should not be so used, but since no other name is apparently available no great harm will be done if this misuse is continued.

Helicella Fér. 1821.—Férussac's livr. 9, 6th April, 1821, contained 6 plates, pp. 1–32, of "Prod. limaçons" and the "explication" of plates 1–47. On page 28 of the "Prodrome" *Helicella* is n.n. It is said to include Lomastomae, Aplostomae, Hygromanes, and Heliomanes, undefined vernacular plurals and no species are mentioned. The part of the "Prodrome" where *Helicella* is properly defined appeared at a later date. *Helicella* is validated on the "explication" which is part of the "Histoire" and a different book. Pl. 27, f. 1 and 2, are said to be *Helicella* (*Heliomanes*) *subdentata* Nobis. Pl. 30, f. 2, is *Helicella* (*Heliomanes*) *planata* Chemnitz. The type must be one of these. Both belong to the *pisana* group and for the type of *Helicella* I designate *H. subdentata* Fér. which has page priority. This replaces *Theba* Risso 1826 of which the type is *pisana* Müller.

Unio Retzius.—The type of this genus is *Mya margaritifera* Linné, validly selected by Turton in 1831, and it should be used for that group. *Lymnium* Oken 1815 type *L. pictorum* (Linné) replaces *Unio* for that species and *tumidum* (Retzius).

Unio durrovensis (Phillips).—This is a valid species and no reason has yet been adduced in support of the view that it is an ecotype.

Pisidium.—The list now given has the assent of all workers, but the true status of *conventus* Clessin has yet to be determined.

Sphaerium pallidum Gray.—It is better to use this name. The opinion has been expressed that it is *S. transversum* Say 1829, but no convincing evidence has been adduced in support of that view. If it really is the American species its distribution is remarkable. It is true that it is not known as a fossil, but *Musculium lacustre* (Müller) is unknown from all Holocene deposits except those of Roman age and later, and *Sphaerium rivicola* (Lamarck) has a similar record (see *Journ. Conch.*, 1938, pp. 50–1).

My best thanks are due to many friends whom I have consulted over the many problems that have arisen in the compilation of this list, and I would specially mention Dr. H. Burrington Baker, G. I. Crawford, Dr. L. R. Cox, A. E. Ellis, Dr. H. A. Pilsbry, A. W. Stelfox, J. R. le B. Tomlin, Hugh Watson, and R. Winckworth, though it must be admitted that their opinions have not always been accepted; but it is quite impossible to attain unanimity.

H = Known from Holocene deposits but not known living.
G.T. = Type of Genus.

Class GASTROPODA.

Order ASPIDOBRANCHIA.

NERITIDAE.

THEODOXUS Montfort 1810.
T. fluviatilis (Linné) 1758. G.T.

VIVIPARIDAE.

VIVIPARUS Montfort 1810.
V. viviparus (Linné) 1758. G.T.
V. fasciatus (Müller) 1774.

VALVATIDAE.

VALVATA Müller 1774.
V. cristata Müller 1774. G.T.
V. piscinalis (Müller) 1774.
V. macrostoma Mörch 1864.

POMATIASIDAE.

POMATIAS Studer 1789.
P. elegans (Müller) 1774. G.T.

ACMEIDAE.

ACME Hartmann 1821.
A. lineata (Draparnaud) 1801. G.T.

HYDROBIIDAE.

HYDROBIA Hartmann 1821.
H. ventrosa (Montagu) 1803. G.T.

PERINGIA Paladilhe 1874.
P. ulvae (Pennant) 1777. G.T.

BYTHINELLA Moquin-Tandon 1856.
(***Cyclostoma viride*** Draparnaud 1805. G.T.)
B. steinii (Martens) 1858 [= **Paludestrina taylori** Smith 1901].

PSEUDAMNICOLA Paulucci 1878.
(***Bythinia Lucensis*** Issel 1860. G.T.)
P. confusa (Frauenfeld) 1863.

POTAMOPYRGUS Stimpson 1865.
(***Melania corolla*** Gould 1848. G.T.,
P. jenkinsi (Smith) 1890.

BITHYNIIDAE.

BITHYNIA Leach 1818.
B. tentaculata (Linné) 1758. G.T.
B. leachii (Sheppard) 1823.

ASSIMINEIDAE.

ASSIMINEA Fleming 1828.
A. grayana Fleming 1828. G.T.

Order PULMONATA.

ELLOBIIDAE.

CARYCHIUM Müller 1774.
C. minimum Müller 1774. G.T.
C. tridentatum (Risso) 1826.

LEUCOPEPLA Peile 1926.
L. bidentata (Montagu) 1808. G.T.

PHYTIA Gray 1821.
P. myosotis (Draparnaud) 1801. G.T.

PHYSIDAE.

APLEXA Fleming 1820.
A. hypnorum (Linné) 1758. G.T.

PHYSA Draparnaud 1801.
P. fontinalis (Linné) 1758. G.T.
P. rivalis (Turton) 1807 [= **P. heterostropha** Say 1819].

LYMNAEIDAE.

LYMNAEA Lamarck 1799.
L. stagnalis (Linné) 1758. G.T.
L. truncatula (Müller) 1774.
L. palustris (Müller) 1774.
L. glabra (Müller) 1774.
L. auricularia (Linné) 1758.
L. lagotis (Schrank) 1803 [= **L. auricularia** var. **acuta** Jeffreys 1830. Brit. Auct.].

L. peregra (Müller) 1774.
var. **burnetti** Alder 1848.
var. **involuta** Thompson 1840.

MYXAS Sowerby 1822.
M. glutinosa (Müller) 1774. G.T.

PLANORBIDAE.

PLANORBARIUS Froriep 1806.
P. corneus (Linné) 1758. G.T.

MENETUS H. and A. Adams 1855.
(***Planorbis opercularis*** Gould 1847. G.T.)
M. dilatatus (Gould) 1841.

PLANORBIS Geoffroy 1767.
P. planorbis (Linné) 1758. G.T.
P. carinatus Müller 1774.
P. albus Müller 1774.
P. laevis Alder 1838 [= **P. glaber** Jeffreys 1862 non Jeffreys 1830].
P. acronicus Férussac 1807 [= **P. strömi** Westerlund 1881. Brit. Auct.].
P. crista (Linné) 1758.
P. vortex (Linné) 1758.
P. vorticulus Troschel 1834.
P. leucostoma Millet 1813.
P. contortus (Linné) 1758.

SEGMENTINA Fleming 1818.
S. nitida (Müller) 1774. G.T.
S. complanatus (Linné) 1758 [= **Planorbis fontanus** Lightfoot 1786].

ANCYLIDAE.

ANCYLUS Geoffroy 1767.
A. lacustris (Linné) 1758. G.T.

ANCYLASTRUM Bourguignat 1853.
A. fluviatile (Müller) 1774. G.T.

SUCCINEIDAE.

SUCCINEA Draparnaud 1801.
S. putris (Linné) 1758. G.T.
S. pfeifferi Rossmässler 1835.
S. elegans Risso 1826.
S. arenaria Bouchard-Chantereaux 1837.
S. oblonga Draparnaud 1801.

AZECIDAE.

AZECA Fleming 1828.
  A. goodalli (Férussac) 1821. G.T.

ZUA Turton 1831.
  Z. lubrica (Müller) 1774. G.T.

VERTIGINIDAE.

PYRAMIDULA Fitzinger 1833.
  P. rupestris (Draparnaud) 1801. G.T.

COLUMELLA Westerlund 1878.
  (***Pupa inornata*** Michaud 1831. G.T.)
  C. edentula (Draparnaud) 1805.

TRUNCATELLINA Lowe 1852.
  (***Pupa linearis*** Lowe 1852. G.T.)
  T. brittanica Pilsbry 1921.

VERTIGO Müller 1774.
  V. pusilla Müller 1774. G.T.
  V. antivertigo (Draparnaud) 1801.
  V. substriata (Jeffreys) 1833.
  V. pygmaea (Draparnaud) 1801.
  V. genesii Gredler 1856.
  V. concinna Scott. 1891. H.
  V. moulinsiana (Dupuy) 1849.
  V. lilljeborgi Westerlund 1871.
  V. alpestris Alder 1838.
  V. angustior Jeffreys 1830.

PUPILLA Fleming 1828.
  P. muscorum (Linné) 1758. G.T.

LAURIA Gray 1840.
  L. cylindracea (da Costa) 1778. G.T.
  L. anglica (Wood) 1828.

ABIDA Turton 1831.
  A. secale (Draparnaud) 1801. G.T.

VALLONIIDAE.

ACANTHINULA Beck 1847.
  A. aculeata (Müller) 1774. G.T.
  A. lamellata (Jeffreys) 1830.

VALLONIA Risso 1826.
  V. pulchella (Müller) 1774. G.T.
  V. excentrica Sterki 1893.
  V. costata (Müller) 1774.

ENIDAE.

ENA Turton 1831.
E. montana (Draparnaud) 1801. G.T.
E. obscura (Müller) 1774.

CLAUSILIIDAE.

LACINIARIA Hartmann 1844.
(***Clausilia plicata*** Draparnaud 1805. G.T.)
L. biplicata (Montagu) 1803.

CLAUSILIA Draparnaud 1805.
C. rugosa (Draparnaud) 1801. G.T.
C. suttoni Westerlund 1882 [= **cravenensis** Taylor 1894].
C. rolphii Turton 1831.

BALEA Gray 1824.
B. perversa (Linné) 1758. G.T.

MARPESSA Gray 1821.
M. laminata (Montagu) 1803. G.T.

FERUSSACIIDAE.

CECILIOIDES Férussac 1814.
C. acicula (Müller) 1774. G.T.

TESTACELLIDAE.

TESTACELLA Lamarck 1801.
T. haliotoides Lamarck Jan. 1801. G.T. [= **T. maugei** Férussac 1821].
T. europaea Roissy 1805 [= **T. haliotidea** Draparnaud July, 1801]
T. scutulum Sowerby 1831.

ENDODONTIDAE.

PUNCTUM Morse 1864.
(***Helix minutissima*** Lea 1844. G.T.)
P. pygmaeum (Draparnaud) 1801.

GONYODISCUS Fitzinger 1833.
(***Helix perspectiva*** Megerle 1816. G.T.)
G. rotundatus (Müller) 1774.
G. ruderatus (Hartmann) 1821. H.

ZONITIDAE.

VITREA Fitzinger 1833.
(***Helix diaphana*** Studer 1820. G.T.)
V. crystallina (Müller) 1774.

RETINELLA Fischer 1877.
(***Helix olivetorum*** Gmelin 1791. G.T.)
R. nitidula (Draparnaud) 1805.
R. pura (Alder) 1830.
R. radiatula (Alder) 1830.
R. petronella (L. Pfeiffer) 1853. H.

OXYCHILUS Fitzinger 1833.
O. cellarium (Müller) 1774. G.T.
O. draparnaldi (Beck) 1838.
O. alliarium (Miller) 1822.
O. rogersi (B. B. Woodward) 1903.

ZONITOIDES Lehmann 1862.
Z. nitidus (Müller) 1774. G.T.
Z. excavatus (Alder) 1830.

VITRINIDAE.

VITRINA Draparnaud 1801.
V. pellucida (Müller) 1774. G.T.
V. major (Férussac) 1807.
V. pyrenaica (Férussac) 1821 [= **V. hibernica** Taylor 1908].

ARIONIDAE.

GEOMALACUS Allman 1843.
G. maculosus Allman 1843. G.T.

ARION Férussac 1819.
A. ater (Linné) 1758. G.T.
A. subfuscus (Draparnaud) 1805.
A. hortensis Férussac 1819.
A. circumscriptus Johnston 1828.
A. intermedius Normand 1852.

LIMACIDAE.

MILAX Gray 1855.
M. gagates (Draparnaud) 1801. G.T.
M. sowerbii (Férussac) 1823.
M. gracilis (Leydig) 1876.

LIMAX Linné 1758.
L. maximus Linné 1758. G.T.
L. cinereoniger Wolf 1803.
L. tenellus Müller 1774.
L. flavus Linné 1758.
L. arborum Bouchard-Chantereaux 1837.

AGRIOLIMAX Mörch 1865.
A. agrestis (Linné) 1758.
A. laevis (Müller) 1774.

ARIOPHANTIDAE.

PETASINA Beck 1847.
P. fulva (Müller) 1774. G.T.

FRUTICICOLIDAE.

FRUTICICOLA Held 1838.
F. fruticum (Müller) 1774. G.T.

HELICIDAE.

TROCHOIDEA Brown 1827.
T. elegans (Gmelin) 1791. G.T.

CERNUELLA Schlüter 1838.
C. virgata (da Costa) 1778. G.T.

CANDIDULA Kobelt 1871.
(***Helix candidula*** Studer 1820. G.T.)
C. caperata (Montagu) 1803.
C. gigaxii (L. Pfeiffer) 1850.

PLANATELLA Clessin 1876.
P. itala (Linné) 1758. G.T.

LONGAEVA Menke 1830.
L. acuta (Müller) 1774. G.T.

MONACHA Fitzinger 1833.
M. cartusiana (Müller) 1774. G.T.
M. cantiana (Montagu) 1803.
M. granulata (Alder) 1830.

ZENOBIELLA Gude and Woodward 1921.
Z. subrufescens (Miller) 1822. G.T. [= **Helix fusca** Montagu 1803].

HYGROMIA Risso 1826.
(***Helix cinctella*** Draparnaud 1801. G.T.)
H. odeca (Locard) 1882 [= **Helix limbata** Draparnaud 1805 non da Costa 1778].

TROCHULUS Férussac 1821.
T. hispidus (Linné) 1758. G.T.
T. libertus (Westerlund) 1871.
T. striolatus (C. Pfeiffer) 1828.

PONENTINA Hesse 1921.
P. subvirescens (Bellamy) 1839. G.T. [= **Helix revelata** Férussac. Brit. Auct.].

HELICODONTA Férussac 1821.
  H. obvoluta (Müller) 1774.

VORTEX Oken 1815.
  V. lapicida (Linné) 1758. G.T.

ARIANTA Turton 1831.
  A. arbustorum (Linné) 1758. G.T.

HELICELLA Férussac 1821
  (***Helix subdentata*** Férussac 1821. G.T.)
  H. pisana (Müller) 1774. G.T.

CEPAEA Held 1838.
  C. nemoralis (Linné) 1758. G.T.
  C. hortensis (Müller) 1774.

HELIX Linné 1758.
  H. pomatia Linné 1758. G.T.
  H. aspersa Müller 1774.

Class PELECYPODA.

Order EULAMELLIBRANCHIA.

Unionidae.

LYMNIUM Oken 1815.
  L. pictorum (Linné) 1758. G.T.
  L. tumidum (Retzius) 1788.

UNIO Retzius 1788.
  U. margaritifera (Linné) 1758. G.T.
  U. durrovensis (Phillips) 1928.
  U. auricularia Spengler 1793. H.

ANODONTA Lamarck 1799.
  A. anatina (Linné) 1758. G.T.
  A. cygnea (Linné) 1758.
  A. minima Millet 1833 [= **elongata** Holandre 1836 and **rothomagensis** Locard 1890].

Sphaeriidae.

PISIDIUM C. Pfeiffer 1821.
  P. amnicum (Müller) 1774. G.T.
  P. supinum A. Schmidt 1850.
  P. henslowanum (Sheppard) 1825.
  P. lilljeborgi Clessin 1886.
  P. hibernicum Westerlund 1894.
  P. nitidum Jenyns 1832.

P. pulchellum Jenyns 1832.
P. milium Held 1836.
P. subtruncatum Malm 1855.
P. obtusale C. Pfeiffer 1821.
P. personatum Malm 1855.
P. cinereum Alder 1838.
P. conventus Clessin 1877.
P. moitessierianum Paladilhe 1866.
P. tenuilineatum Stelfox 1918.
P. vincentianum B. B. Woodward 1913. H.

SPHAERIUM Scopoli 1777.
S. corneum (Linné) 1758. G.T.
S. rivicola (Lamarck) 1818.
S. pallidum Gray 1856.

MUSCULIUM Link 1807.
M. lacustre (Müller) 1774. G.T.

Dreissenidae.

DREISSENA Van Beneden 1835.
D. polymorpha (Pallas) 1771. G.T.

2. Introduced Species.

Cochlostoma septemspirale (Razoumowsky) 1789.
Cochlostoma patulum (Draparnaud) 1801.
Physa acuta Draparnaud 1805.
Physa gyrina Say 1840.
Chondrina similis (Bruguière) 1792.
Planatella neglecta (Draparnaud) 1805.
Trochoidea pyramidata (Draparnaud) 1805.
Trochulus umbrosus (C. Pfeiffer) 1828.
Clausilia dubia Draparnaud 1805.
Ena detrita (Müller) 1774.

3. Greenhouse Aliens.

Pleurodiscus balmei (Potiez and Michaud) 1837.
Helicodiscus parallelus (Say) 1821.
Hawaiia minuscula (Binney) 1840.
Subulina octona (Bruguière) 1789.
Leptinaria urichi (Smith) 1896.
Opeas clavulinum (Potiez and Michaud) 1838.
Opeas pumilum (L. Pfeiffer) 1840 [= **Opeas goodalli** (Miller) 1822. Brit. Auct.].
Cochlicella decollata (Linné) 1758.

OBITUARY: J. G. DALGLIESH.

By R. WINCKWORTH.

J. GORDON DALGLIESH was born in India in 1887 and died on 21st October, 1940. Throughout his life he was interested in natural history; his taste was catholic—birds, mammals, seashore life, snails, wild flowers, brachiopods were among the subjects he took up. He had a beautifully arranged collection of shells, among which Japanese species were prominent. Indeed most things Japanese interested him and he had some good china and netsuke. He was at one time on a tea estate in the Darjeeling district; I remember an occasion, when I happened to have a particularly choice Indian tea, how he set down his cup with delighted surprise and recognized the tea as coming from that same estate on which he had worked long before—and he was right. After his retirement from India he lived in Hove for many years, and during the four years' war took up work in the Brighton Municipal Museum, where he continued for many years. He pursued a variety of subjects with successive waves of enthusiasm, dropping each interest in turn to be revived with the same enthusiasm later. He was a good companion in field work: I was with him when he found the first *Crepidula* (living on *Mytilus*) recorded from the Brighton district. His best work is a really excellent little book on the birds of India. His quiet friendliness and wide interests were a valuable stimulus to the Brighton Natural History Society. His later years were spent at Horsham; he died suddenly while on a short holiday in Gloucestershire. He had been a member of our Society since 1925, and was also a member of the Malacological Society of London and a Fellow of the Linnean Society.

LYMNAEA PEREGRA IN WEST SUTHERLAND.

By F. Taylor.

(*Read before the Society*, 15*th February*, 1941.)

Much interest has recently been taken in *Lymnaea peregra* and its allies; mainly arising from the breeding experiments made by the late Professor Boycott, described and illustrated in a masterly manner by him in the *Proceedings of the Malacological Society*, July, 1938. As a shell-collector, I have taken a great interest in this variable species; and had a long ungratified desire to see its involute form in its natural habitat.

The wonderful find of this variety in a mountain tarn in West Sutherland, and the first for Great Britain, was made by Oldham in 1935, and an account of his experiences appeared in the *Journal of Conchology* 1935, vol. 20, p. 161, and *Scottish Naturalist*, March–April, 1936. The reading of these, and a personal letter and map from Mr. Oldham, whetted my appetite still further, and the journey was made to Inchnadamph on the 13th June, 1939. On the following day, weather conditions appearing favourable, I set out for Loch Fleodach Coire, a bare mountain tarn at 1,300 feet in wild country about 2½ miles north-east of the village. The route is by a deer path that is plainly marked on the 1 in. Ordnance Survey Map, Scotland, Sheet 15, and is not very difficult to negotiate. I had no trouble in finding the tarn, and commenced my search near the outlet stream, where Oldham " found *involuta* present in plenty, crawling on the stones and hiding beneath them, where there were also many newly-hatched young and egg-capsules ". Alas! I found conditions very different from those on the days of his visits on 28th June and 2nd July, 1935.

No creatures of any kind were seen on the exposed sides of the stones, but on turning them over, egg-capsules of Lymnaea were found in plenty; some stones having half a dozen or more, containing from two to twelve eggs. A few newly-hatched young were seen, but it was only after an hour's close search, and the turning over of countless stones, that an adult snail was found, and only fifteen *involuta* were taken over a long marginal area in the course of a five hours' search; no other species of mollusca were found, though a few valves of Pisidia were seen. Doubtless the faunal conditions were due to the phenomenally hot sunny weather of the preceding three weeks of May and June, which prevailed throughout the British Islands, during which the waters of this exposed shallow loch would absorb the heat, abnormally force the breeding of the snails, the laying of their eggs, and their subsequent death.

During the whole of my search I kept a look out for dead shells, but only saw one, and this fell to pieces in my attempt to pick it up; from this I assume that the decomposition of the snail would disintegrate the very thin shell, and thus account for their absence. The low temperature and the gloomy conditions on the day of my visit may have interfered with the activities of the snails; for soon after my arrival at the tarn the clouds lowered and a heavy shower of rain fell, after which the wind dropped and heavy mists covered the mountain tops and rolled over the water; this gave me some concern, and I was thankful to get away before the mists closed down to make conditions impossible for my return.

On the 16th June I visited Loch Mhaolach-coire, known to the fishermen as the "Gillaroo Loch", at about 850 feet, 2 miles to the south-east of Inchnadamph. Here again the early summer conditions of the preceding weeks had evidently forced the breeding of *Lymnaea peregra*, so instead of finding plenty of large adult examples I found but a few uninteresting juveniles. Other shells (all bivalves) found were several *Pisidium cinereum*, several *Pisidium nitidum*, two *Pisidium milium*, and many *Pisidium lilljeborgii*. This loch is described very fully by Boycott and Oldham, *Scottish Naturalist*, March–April, 1936.

On the same day Dr. and Mrs. C. W. Walker, of Hereford, who were spending a holiday at Inchnadamph, kindly handed over to me a few living *Lymnaea peregra*, which they had procured from Lochan Bealach Cornaidh at 1,400 feet on Quinag $4\frac{3}{4}$ miles north-west of Inchnadamph. This form has a very thin shell with tiny spire (Fig. 2). Dimensions $11{\cdot}7 \times 8{\cdot}2$ mm. The extreme thinness of the shell would suggest water with little calcium content.

The Càm Loch at Elphin, at 405 feet, with several islands, one well wooded, is very attractive, and easily reached. On the 18th June I went down to the boat landing, directly below the small graveyard; and close by the boats found a few *Lymnaea peregra* crawling over the stones which are covered with algae; they were in all stages of growth, from small juveniles to mature examples, largest $18{\cdot}0 \times 15{\cdot}0$ mm.; are thick-shelled, and of a form approaching *L. auricularia*, with globose body and expanded mouth (Fig. 3). Dimensions $16{\cdot}0 \times 12{\cdot}0$ mm. I searched the margin of the loch for about 100 yards on the south side of the landing place, and 400 yards on the north side, and found the *Lymnaea* in small numbers throughout.

About 20 yards south of the boats an extraordinary living specimen was found on the underside of a large stone. This specimen is completely involute with the apex sunk in the succeeding whorls, and is in perfect and clean condition, but unlike the typical

L. involuta has a thick shell of large dimensions, 15·0 × 11·0 mm., with long body whorl and mouth, which are contracted at the upper angle of the shell; it shows no sign of injury or distortion, but a perfect symmetry (Fig. 4); and as will be seen by reference to the outline drawings is very different to the normal specimens (Fig. 3) with which it was found. It bears some resemblance to *L. burnetti*, but differs from it in its more oblong, less globose form, and its deeper sunk spire. An intensive search in the immediate neighbourhood produced no others of this involute form; though normal examples occurred sparingly.

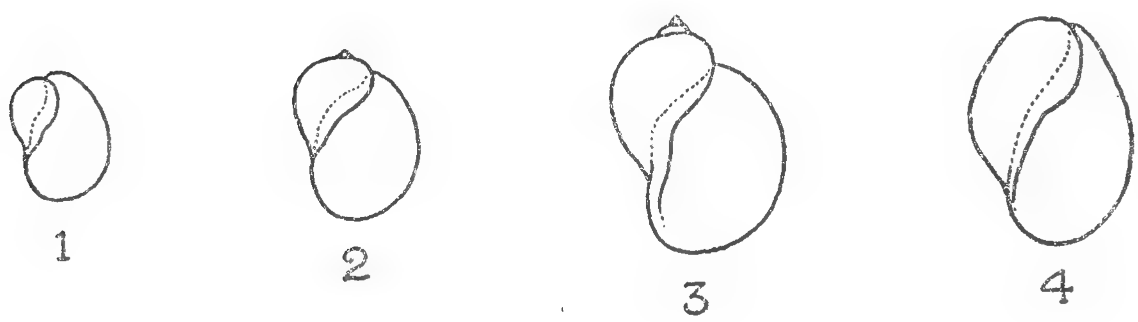
I can suggest no reason for the production of this abnormal Lymnaea in the midst of a normal population, but evidently it cannot be as simple as it must be with that of the typical *involuta*, which produces no variation in its restricted habitat in isolated mountain tarns of non-calcareous waters. A fair amount of plant life occurs in that part of the loch examined, mainly *Myriophyllum*, and stranded specimens of a *Potamogeton* of the *rufescens* group were commonly met with.

This plant life and the well-developed thick-shelled Lymnaea suggest that the water is substantially calcareous; and doubtless a systematic search with dredge under favourable conditions would reveal other species of mollusca.

I have given precise details of the spot on which the amazing snail was found, in the hope that some future investigator will use them, and find others of this form, from which breeding experiments can be made that may help in the solution of the problem set before us by this individual.

The outline drawings by John Armitage are full size.

1.	*Lymnaea involuta*	Dim.	8·5 × 6·8 mm.	
2.	,, *peregra*	,,	11·7 × 8·2 mm.	
3.	,, ,,	,,	16·0 × 12·0 mm.	(normal)
4.	,, ,,	,,	15·0 × 11·0 mm.	(involute)



A RECENT ADDITION TO THE BRITISH FAUNA.

By D. Keith McE. Kevan, B.Sc.

A considerable amount of work has recently been done by the writer concerning this snail, but up to the present nothing has been published to record its discovery in this country, so that it might be of interest to give a brief account of its occurrence in Britain prior to the appearance of a more comprehensive paper.

The snails were first taken in this country by the writer's father, Mr. D. K. Kevan, in July, 1929, but it was not until 1940 that their identity became known. They were first identified as *Lymnaea* (*Stagnicola*) *palustris* Müll., but this was not considered satisfactory, and shells (*without* the bodies of the animals) were sent to the late Professor A. E. Boycott, who labelled them " an abnormal variety of *L. peregra* ", and as such they lay more or less forgotten. Later I concluded that it was neither species, though in some respects it resembled both, and it was eventually established that the snail belonged to the common North American species, *Lymnaea* (*Stagnicola*) *catascopium* Say.

The shell is somewhat like that of *Lymnaea* (*Radix*) *peregra* Müll., but is narrower and with a much sharper spire, while the tentacles, instead of being short and blunt, as in that species, are long and pointed as in *L. palustris*, and the colour of the body is grey and not dirty yellowish.

From *L. palustris* it differs in the broader, smoother shell with a larger aperture, while the tentacles are even sharper, and slightly forwardly curved.

Internally the genitalia are very different from those of *L. peregra*, the spermatheca being long-stalked and not sessile. The genitalia of *L. catascopium* differ from those of *L. palustris* in that the spermatheca is round and not pyriform, and the penis-sheath is rather shorter, relative to the preputium. (*Vide* F. C. Baker, 1911, *Monograph of the N. American Limnaeidae*, Chicago Acad. Sc., Spec. Pub. No. 3.)

L. catascopium occurs in a warm engine-pond in the Scottish port of Leith, where it breeds prolifically at a constant temperature of 27° C. The pond is in the yard of a well-known firm of timber importers, and it must have been upon the logs of Canadian birch which are sometimes floated there that the snails arrived, some time between the years 1900 and 1929. They are extremely numerous, having a present population of 54 per square foot, and it is possible that they might become troublesome if they were to be introduced into canals, though it is not likely that they would multiply so abundantly as *Dreissena polymorpha*.

These Leith specimens are particularly interesting on account of the very great variation shown in view of the uniform environment of the pond—both with regard to the actual proportions of the shells, and also their form. The body-whorl, which is normally rather smooth, is very often varicated and may frequently be curiously dilated or even ribbed, while the lip may be greatly expanded or reflexed, often so much so that it curves right back upon itself, forming a thick white rim.

It is chiefly due to this variation that the identification was so uncertain, and the cause of this has not yet been determined, for it does not appear to be due to the high temperature at which the snail is found, nor to the supply of calcium, nor to any other factor that I can surmise.

It is hoped to publish the observations, as far as they have gone, on the variation in this species in Leith, in the near future.

ANODONTA MINIMA MILLET IN NORFOLK.

By A. E. Ellis.

While looking through the W. J. O. Holmes cabinets of British Mollusca in the Norwich Castle Museum recently, I noticed three specimens of *Anodonta minima* Millet (= *Pseudanodonta rothomagensis* Locard = *elongata* Holandre), in a drawer containing a miscellaneous assortment of *Anodonta anatina* and *A. cygnea.* The *A. minima* are not labelled, but as many of the other two species of *Anodonta* are from localities in Norfolk, it seemed likely that the *A. minima* might be from the same county.

In April, 1941, I found *A. minima* in the river Yare east of Norwich at Thorpe, Postwick and Surlingham, thus confirming the existence of this mussel in East Norfolk. *A. minima* and *A. anatina* occur in the Yare in approximately equal numbers, while *A. cygnea* is somewhat less frequent. The Norfolk specimens of *A. minima* attain a good size for the species, the largest shell, found at Surlingham ferry, being 85 mm. in length.

It is probable that the shells in the Holmes collection also came from the river Yare, and had been mistaken for a form of *A. anatina.* Incidentally, most of the shells so named in this collection are really *A. cygnea*, including a peculiar, shortened form from South Walsham Broad, which does bear some superficial resemblance to *A. anatina.* Mr. E. A. Ellis informs me that he has found shells of this form of *A. cygnea* in South Walsham Broad with shells of barnacles on them.

EDITORIAL NOTES.

We regret to record the loss of Lt. Vernon W. MacAndrew on or about 25th June, 1940. His 196 ton yacht, *Campeador V*, had been taken over by the Admiralty and struck a mine in the Channel.

MacAndrew was a member of a famous shipping family and the third of the name to take an enthusiastic interest in conchology. He had dredged in the Red Sea, Philippines, and Dutch East Indies, but unfortunately cared only for a few of the larger genera, especially cowries and cones. He found the Red Sea dredging disappointing on the whole, though *Cypraea camelopardalis* Perry was pretty common and a single example of *C. macandrewi* Sowerby, which was named after Robert MacAndrew, turned up.

In 1918 he bought part of the splendid collection amassed by his uncle, J. J. MacAndrew, of Ivybridge, for £600, and in 1919 the de Burgh collection for £1,000. We understand that all his shells are either bequeathed or presented to the British Museum. He was nearly 60 years of age.

The Cheshire Rural Community Council has recently issued its first publication under the title of *Pre-historic Cheshire*, the authors being Mr. J. W. Varley and Dr. J. W. Jackson, with maps by Miss Lily F. Chitty.

This handbook is intended to be the first of a series dealing with the history of Cheshire, and takes one up to the Roman Conquest. The price of it is 4*s*. 6*d*. and members are recommended to write to the Hon. Secretary, who is one of the authors, if they want to secure a copy.

In the *Proceedings Isle of Wight Natural History and Archaeological Society* for 1938 (vol. iii, pt. i, pp. 30–2) Captain G. C. C. Damant, R.N., records the effect of temperature on the grazing of *Lymnaea peregra*. He uses the term grazing advisedly " because there is a rhythmic action of the jaws accompanied by a slow forward motion of the whole body which reminds one of sheep on pasture, and it seems to go on all day and probably all night as well ". His observations were made with the aid of a glass tank in which a thermometer was suspended and the temperature of the water was left entirely to nature. He has found that the *peregra* at or below 36° F. do not graze at all ; at 37° their jaws work at the rate of six strokes a minute ; at 45° this rate is doubled, and at 55° more than trebled ; the highest rate noted was 35 per minute at a water temperature of 73°. So constant did these figures prove to be that it was possible to ascertain the temperature of the aquarium within a degree or two by counting the rate of biting.

Mr. F. C. Baker sends for review his *Fieldbook of Illinois Land Snails*, Manual 2, Nat. Hist. Survey Division, State of Illinois, Urbana, Ill. It is a handy little volume of 166 pp., with good woodcuts of every species listed, and a few photos of typical habitats. There are 34 pp. of introductory matter, dealing tersely with anatomy, collecting, identification, and with the physical features of Illinois.

Altogether it can be warmly recommended as a most useful handbook of its kind.

The current number of the *Nautilus* records a very flourishing colony of *Helix pomatia* in the U.S.A. on the banks of the Milwaukee River about 10 miles north of Milwaukee City, Wisconsin. Inquiries made by the discoverer, Dr. R. G. Washburn, elicited that the colony had originally been planted on an island in the river, and that live specimens must have been washed across to the mainland by a freshet and have firmly established themselves.

Professor G. D. Hale Carpenter, Hope Professor in the Department of Entomology at Oxford, has just presented to the Society a collection of shells left by the late Commander J. J. Walker, R.N.

Walker was a most versatile collector of everything, and there were few parts of the world which he had not collected in. I recollect a mutual friend calling on him on H.M.S. *Penguin* at Gibraltar, and finding his cabin littered with his dress shirts to which he had been obliged to pin lepidoptera owing to a shortage of corked boxes.

Sea-Anemones and Nudibranchs.— On several occasions I have offered various spp. of opisthobranchs to anemones, with varying results. Thus, when I placed a *Facelina drummondi* (A. & H.) touching a small *Actinoloba dianthus* the mollusk wriggled convulsively away from the anemone's tentacles, and after a few seconds the anemone drew back its tentacles, and *Facelina* crawled away unhurt. Again, *Facelina longicornis* (Mont.) was fed to a fair-sized *Actinia equina*. The anemone at once closed its tentacles over most of the mollusk's body, and held the struggling animal for several seconds. Then the anemone loosed the *Facelina* which crawled out apparently none the worse. When I gave a *Limapontia capitata* (Müller) to a fair-sized *Actinia equina* there was the same behaviour as in the case of *Facelina longicornis*, ending in the release of the opisthobranch.

In May, 1936, I kept for several days three *Eubranchus* (= *Galvina*) *tricolor pallidas* (A. & H.), each about 7 mm. long when extended, with a small *Sagartia* (sp. indet.). The *Sagartia* was fully opened, but although the mollusks occasionally seemed to touch the column of the anemone neither appeared aware of the contact.

N. F. McMillan.

Food of Tealia crassicornis Müller.—Nudibranchs seem to be unpalatable to most littoral animals, but *Adalaria proxima* (A. & H.) at any rate seems to be appreciated as a meal by *Tealia*. In May, 1936, I found half a dozen examples of *Adalaria* on *Laminaria digitata* near L.W.M. at Greenisland, co. Antrim, and out of curiosity fed one to a large *Tealia* near by. The anemone promptly engulfed the mollusk. I waited some little time, but the *Adalaria* was not " returned ".

N. F. McMillan.

Papuina fringilla Pfeiffer.—A sinistral shell of this species has come to light in the Cuming Collection in the British Museum. The shell is unbanded and of yellowish colour ; peristome white with strong dentition near the base of the columella. Locality given as Admiralty Isles.

Dimensions : diam. max. 22·25, min. 18·65 mm. ; alt. 13·1 mm.

A. J. Peile.

(*Read before the Society*, 15*th February*, 1941.)

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN & IRELAND.

663rd Meeting, held in the rooms of the Linnean Society at Burlington House, London, 15th February, 1941.

The President, Mr. A. E. Ellis, in the chair.

Present.—Members : Dr. A. T. Hopwood, Lieut.-Col. A. J. Peile, Mr. A. E. Salisbury, Mr. R. Winckworth, Mr. A. Wrigley. Visitors : Professor F. J. Cole, F.R.S., Dr. Nellie B. Eales.

Appointment of Auditors.

Mr. C. H. Moore and Mr. A. K. Lawson were reappointed Auditors.

Annual Reports.

The Annual Report of the Council ; the reports of the Leeds and North Staffs. branches ; and the reports of the Recorders were presented and adopted.

Election of Officers and Council.

The Officers and Council for 1940–1 were duly elected (see p. 257).

Subscription to Zoological Record.

The sum of two guineas was voted to the Zoological Society of London, as a subscription towards the expenses of publishing the *Zoological Record*.

Vote of Thanks.

A vote of thanks to Mr. J. R. le B. Tomlin, in recognition of his work in connection with the Society since the outbreak of war, was unanimously approved.

Papers Read.

" Ecological Notes," by A. E. Ellis.

" *Lymnaea peregra* in West Sutherland," by Fred Taylor.

" Sinistral *Papuina fringilla* Pfr.", by Lieut.-Col. A. J. Peile.

" Notes on *Limapontia depressa* var. *pellucida* Kevan kept under artificial conditions," by D. K. McE. Kevan.

" *Littorina saxatilis compressa* Jeff.", by Mrs. N. F. McMillan.

" List of the British Non-Marine Mollusca," by A. S. Kennard.

The following papers, published in the *Journal of Conchology*, vol. 21, no. 8, were read in title :—

" Molluscan Fauna of Burton Marsh, Cheshire," by Mrs. N. F. McMillan.

" *Testacella scutulum*—method of cleansing," by Lionel E. Adams.

" The Mollusca of a Norfolk Broad " (Presidential Address), by A. E. Ellis.

" An undescribed Land Shell from South-West Africa," by Major M. Connolly.

" *Rhiostoma macalpine-woodsi* Laidlaw," by Dr. F. F. Laidlaw.

ANNUAL REPORT, 1939–1940.

This is the Sixty-Fourth Annual Report of the Society.

During the past year, despite war-time conditions and the consequent loss of some of our members to the Services in one capacity or another, the Officers and Council have endeavoured to carry on the work of the Society.

Reports of one death (Rev. E. P. Blackburn) and of one resignation (W. R. B. Oliver) have been received, and the membership to-day is 203, including Honorary and Institutional members.

It has not been possible to hold the usual monthly meetings at the Manchester Museum, and the papers and notes submitted have been sent to the Hon. Editor for insertion in the *Journal* at his discretion or that of the Emergency Committee.

Since the Emergency Annual Meeting in London, on 24th November, 1939, two numbers of the *Journal* have been issued, viz. vol. 21, no. 7, 13th April, 1940, comprising 36 pages of text and 1 text-figure ; and no. 8, 17th January, 1941, comprising 36 pages of text.

The Council is pleased to record the following awards made by the Geological Society of London to two of our members : Wollaston Medal to Mr. Henry Woods, and Lyell Medal to Professor H. L. Hawkins.

The revised list of British Non-Marine Mollusca mentioned in the last Annual Report is now completed by Mr. A. S. Kennard and it is hoped to publish it at an early date.

The revised Census of British Non-Marine Mollusca is well in hand but its publication will be delayed as the Recorder is on war work and unable to devote much time to the matter.

Reports have been received from the Recorders for Marine and Non-Marine Mollusca ; also from the Leeds and North Staffordshire Branches. Owing to the war the London Branch has been unable to meet.

Additions to the Library have been received from Drs. Paul Bartsch, Hans Schlesch, E. H. Madge, and J. W. Jackson ; also from Mr. C. Oldham (large number of author's reprints on *Pisidium*, *Lymnaea*, and Ciliary Mechanisms of Lamellibranchs).

Donations to the Cabinet have been made by Dr. Hans Schlesch (locality sets of *Unio crassus* from Latvia), and by Mr. L. E. Adams, who has presented his large and comprehensive collection of British Non-Marine Mollusca, comprising many locality sets, together with his Catalogue of the same.

RECORDER'S REPORT (NON-MARINE MOLLUSCA).

ONLY a few members have sent specimens for verification since last Report. Dr. J. W. Jackson submitted his comprehensive collection of *Succinea* and Mr. J. E. Cooper made some useful additions to the list for Bedford.

The task of revising the Census is well in hand and the maps showing distribution of species have been completed.

Hants, S. (11). *Succinea pfeifferi*, *S. putris* (C. A. Ashford in coll. J. W. Jackson).

Bedford (30). *Milax sowerbyi*, *Oxychilus lucidus*, *S. putris*, *S. pfeifferi*, *Potamopyrgus jenkinsi*, *Pseudanodonta minima*, *Pisidium obtusale* (J. E. Cooper).

Hereford (36). *S. pfeifferi* (J. W. J.).

Stafford (39). *S. pfeifferi* (J. W. J.).

Flint (51). *S. pfeifferi* (J. W. J. & R. Standen).

Yorks, S. W. (63). *S. putris* (J. W. J.).

Cumberland (70). *S. putris* (J. W. J.).

Ayr (75). *Planorbis spirorbis* (empty shell), *Bithynia tentaculata* (Mrs. M. E. Waterston).

Renfrew (76). *Milax sowerbyi* (gardens), *Arion intermedius*, *S. pfeifferi* (A. R. Waterston).

Kincardine (91). *S. pfeifferi* (F. Booth).

Dumbarton (99). *S. pfeifferi* (J. W. J.).

Antrim (114). *S. oblonga*, *S. putris* (J. W. J.).

Down (115). *S. putris* (J. W. J.).

Cavan (121). *S. putris* (J. W. J. & R. Welch).
Louth (122). *S. putris* (J. W. J. & R. W.).
Cork, E. (146 E). *S. pfeifferi* (J. W. J.).

MARINE RECORDER'S REPORT.

OWING to the war little work has been done. The valuable contributions of lists from collections in the Manchester Museum, which were being sent to me by Dr. Jackson, have not been completed. When the war comes to an end, enabling this work to be finished, the information from this source will be of great value. In spite of the difficult times Mr. W. Fowler has been able to send information of great interest from time to time. This observer has spent much time in the investigation of the distribution of *Arca tetragona britannica* Reeve on the Falmouth section of the coast and has reported it there at several new stations. He has also sent me " live " shells of *Ividella excavata harveyi* (Thompson) from near Falmouth; this is the first record of living specimens of this animal from Cornwall as far as I know. He has also sent records of *Alvania beanii beanii* (Thorpe), *Thracia* (*Ixartia*) *distorta* (Montagu), *Galeomma turtoni* Sowerby, *Tornus subcarinatus* (Montagu), *Sphenia binghami* Turton, *Turbonilla jeffreysii* (Forbes and Hanley), *Haedropleura septangularis* (Montagu), *Lima hians glaciata* (Salis), *Barbatia lactea* Linné, *Galeodina carinata* (da Costa), *Lepidopleurus cancellatus* (Sowerby), *L. scabridus* (Jeffreys), and *Gastrochaena dubia* (Pennant), all living. In many cases he generously sent me examples of many of these and other species.

YORKSHIRE CONCHOLOGICAL SOCIETY.

44th ANNUAL REPORT, 1940.

DURING the year the activities of the Society were somewhat curtailed by the unusual weather and war conditions, but the whole of the meetings and excursions (with the exception of one in each category) have been held and the interest sustained, although with attendances rather less than usual.

Papers were read by Mr. H. J. Armstrong, " Shell Money " ; Mrs. E. M. Morehouse, " Some facts about the Cypraeidae " ; Dr. H. C. Versey, " Fossil Freshwater Mollusca " ; and by the President, Mr. B. Bussey, " Radulae."

Excursions were held to Fairburn, Rodley, and Walton Hall, near Wakefield, when 17, 1 and 5 species respectively were taken.

The 44th Annual Meeting was held on the 26th October, when the following Officers for 1941 were elected :—

President.—Mrs. A. Thurgood.
Hon. Secretary.—W. Thurgood, 16 Moss Gardens, Alwoodley, Leeds.

The remaining Officers were re-elected, with the strengthening of the Council by the addition of Mrs. E. M. Morehouse.

There is little of interest to record in the takings during the year. Mr. and Mrs. Thurgood took *Cepaea nemoralis* vars. *albolabiata* (Martens)—*roseolabiata* (Taylor), and *undulata* (Gentiluomo) between Garforth Railway Station and Garforth Bridge on the 13th April.

A syllabus has been arranged for 1941 with five papers, the Presidential Address and four excursions. It is hoped that, if conditions do not worsen, we shall have an interesting year.

W. THURGOOD, *Hon. Secretary*.

REPORT OF THE NORTH STAFFORDSHIRE BRANCH.

Owing to the exigencies of the times, members have been prevented from doing much field work. However, Messrs. W. Hill and H. Emmett have done a little collecting, and the former has kindly supplied me with notes from which I have selected the following :—

H. caperata, var. *obliterata*, Cheddleton. He remarks, " they are beautiful shells, one in particular with broad translucent bands. Taylor's Monograph considers this var. to be a rarity." *V. pulchella* and *costata* from Bunster, Manifold Valley ; also *P. muscorum* from the same locality. *C. nemoralis*, band formula 023 (45) which, according to Taylor's Monograph, is a very uncommon form. Loc. Froghall. He also took a beautiful yellow shell with white lip, yellow rib, and clear band. Last October he visited the *hortensis* colony at Cliffe Park, near Rudyard, and was astonished to find that all the *hortensis* on the left-hand side had been destroyed by mice or voles. The broken shells were to be seen in clusters under the coltsfoot leaves, numbering from ten to twenty or more in each cluster. There must have been hundreds of them both young and old. I did not find a live shell on that side, yet on the opposite side they appeared to have escaped attention. At Consall I took three *rotundata*, *m. subscalariforme*, and at Cheddleton two *C. caperata*, *m. subscalariforme*. The following is a list of species I have found in association under the cliffs at the top of the Devil's Staircase, Consall (left-hand side going up) :—

A. arbustorum, *C. laminata*, *C. rugosa*, *E. obscura*, *P. cylindracea*, *H. rotundata*, *A. aculeata*, *C. minimum*, *V. crystallina*, *H. alliaria*, *H. nitidula*, *H. cellaria*, *Z. excavatus*, *V. columella* (one dead shell), *H. fulva*, *H. fusca*, *L. maximus*, *A. ater*, *A. agrestis*, and *L. marginatus*. *C. laminata*, *C. rugosa*, *E. obscura*, *P. cylindracea*, and *Z. excavatus* appear to be a very rare association here. Finds worth recording for 1940 are *H. Fusca* from the wood at the canal basin at Froghall, *C. hortensis*, with band formula 02000, from Rudyard, and *C. nemoralis*, with 02300, at Cheddleton.

Mr. H. Emmett took a number of *H. striolata* var. *alba* at Froghall.

The only personal note I have to add is the finding of a specimen of *Milax gracilis* (Leydig) in my garden at Normacot, Staffordshire, in 1939. I submitted the slug to Mr. A. R. Waterston and he kindly confirmed my naming. This, I believe, is the first authentic record for this species in Staffordshire. Last year, 1940, I came across three others in the same place.

B. Bryan, *Hon. Secretary*.

664th Meeting, held at the British Museum (Natural History), 14th March, 1941.

The President (Mr. A. E. Ellis) in the chair.

Present : Mr. A. Blok, Dr. A. T. Hopwood, Mr. A. S. Kennard, Lieut.-Col. A. J. Peile, Mr. A. E. Salisbury, Mr. R. Winckworth, Dr. L. R. Cox (visitor).

Members Deceased.

The President reported the death of J. Gordon Dalgliesh, who had been a member of the Society for fifteen years, and had contributed a number of papers on the non-marine Mollusca of Sussex ; and of C. P. Richards, at the age of 90 years, who was elected a member of the Society in 1900.

Paper Read.

" List of the British Non-Marine Mollusca," by A. S. Kennard.

Mr. Kennard, who was prevented by illness from attending the previous meeting, at which his paper was read in title, explained the principal reasons for drawing up a revised list of British Land and Freshwater Mollusca, and a discussion on the nomenclature of the non-marine mollusca took place.

ACCOUNTS FOR THE YEAR ENDED 31st DECEMBER, 1940.

Income and Expenditure Account.

Dr.

	£ s. d.	£ s. d.	£ s. d.
To Annual Subscriptions—			
For 1940—			
68 at 10*s*. . . .		34 0 0	
8 at 5*s*.		2 0 0	
On account . . .		1 5	
			36 1 5
,, Sale of Publications			6 2 6
,, Advertisements			15 0
,, Transfer from Life Membership Fund . .			16 15 1
			£59 14 0

Cr.

	£ s. d.	£ s. d.	£ s. d.
By publication and distributing of *Journal*—			
Vol. XXI, Part 7 . .		24 13 2	
Authors' Reprints . .		3 2 9	
			27 15 11
,, Printing and Stationery			1 15 6
,, Fire Insurance			10 0
,, Warehousing Stock			1 10 0
,, Subscriptions—			
Malacological Society . .		1 1 0	
Lancs. and Chesh. Fauna Com.		5 0	
Zoological Society (Record) .		5 0	
			1 11 0
,, Publications Sales Refund			6 8
,, Officers' Expenses and Bank Charges . .			1 19 4
,, Balance, being excess of Income over Expenditure			24 5 7
			£59 14 0

Life Membership Fund.

	£ s. d.
To Amount of Fund, 1st January, 1940 .	355 4 0
,, Dividend and Interest	16 15 1
	£371 19 1

	£ s. d.
By Transfer to Income and Expenditure Account	16 15 1
,, Amount of Fund, 31st December, 1940 .	355 4 0
	£371 19 1

Research Fund.

	£	s.	d.		£	s.	d.
To Amount of Fund, 1st January, 1940	281	16	11	By Amount of Fund, 31st December, 1940. Cap.	200	0	0
,, Dividend and Interest	18	6	8	,, Balance of Transfer and Accumulated Interest	100	3	5
	£300	3	5		£300	3	5

BALANCE SHEET.

Liabilities.	£	s.	d.	£	s.	d.	Assets.	£	s.	d.	£	s.	d.
Annual Subscriptions paid in advance					10	0	*Investments.*						
Life Membership Fund				355	4	0	4% Funding Loan, £408 4*s.* 11*d.*, cost				350	0	0
Research Fund				300	3	5	3% Defence Bonds (Transfer of 4½% Conversion Loan)				200	0	0
Balance of Income and Expenditure Account—							3½% Conversion Loan, £40 11*s.* 8*d.*, cost				40	0	0
As on 1st January, 1940	125	18	1										
For 1940	24	5	7	150	3	8	Cash at Bankers				216	1	1
				£806	1	1					£806	1	1

NOTE.—Assets in addition to those set out in the Balance Sheet are (*a*) Library, (*b*) Cabinets and Collections, (*c*) Stock of unsold publications, (*d*) Annual Subscriptions in arrear.

Audited and found correct.
C. H. MOORE.
A. K. LAWSON.
24th February, 1941.

ALBERT E. SALISBURY,
Hon. Treasurer,
31st December, 1940.

Malacological Society of London.

Hon. Sec.: L. R. Cox, D.Sc., Brit. Mus. Nat. Hist., Cromwell Road, S.W.7.

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. . THE . .

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THE
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DISTRIBUTION OF *CLAUSILIA CRAVENENSIS* TAYLOR (*SUTTONI* WESTERLUND) IN BRITAIN.

By E. Percy Blackburn.

(*Read before the Society, 2nd February,* 1940.)

In 1934 I published a general Survey of the Land and Freshwater Mollusca of Northumberland and Durham (1) and gave records of all known localities for this species in the two counties. The late Professor A. E. Boycott urged me to make a more detailed study of the species and include the whole area of its known distribution. To that end he kindly placed at my disposal the official Comital Census of the Conchological Society of Great Britain and Ireland. Mr. H. J. Armstrong, the Recorder of the Yorkshire Branch of that Society, provided me with the records for his area, and Mr. A. R. Waterston, of the Royal Scottish Museum, Edinburgh, with the Scottish records. I am also indebted to Messrs. A. S. Kennard, Hugh Watson, J. R. le B. Tomlin, Dr. J. Wilfrid Jackson, J. Davy Dean, Professor J. W. Heslop Harrison, B. R. Lucas, A. T. Lofthouse, G. W. Temperley, and others for their personal records. Dr. A. Raistrick has kindly helped me with the geological data, and Dr. K. B. Blackburn has given me much valuable help.

TABLE OF LOCALITIES FOR *CLAUSILIA CRAVENENSIS*.

Key to the abbreviations used in the Table.

Geological.

B	Brockram Calcareous Pebbles.
BV	Borrowdale Volcanic.
C	Coal Measures.
CL	Carboniferous Limestone Series.
GL	Great Limestone.
Gn	Gneiss.
L	Mountain Limestone (proper).
Li	Lias.
Mag	Magnesian Limestone.
MG	Millstone Grit.
NR	New Red Sandstone.
O	Oolite.
S	Silurian (Upper) Bannisdale Slates.
W	Whinstone (Basalt).

Sources of Records.

C	Conchological Society of Great Britain and Ireland.
CY	Ditto. Yorkshire Branch.
L	*Lancashire Naturalist.*
Nat	*The Naturalist.*
N	*Northern Naturalists' Union Transactions* (1). (These include all old records of Northumberland and Durham.)
S	Scottish Land and Freshwater Mollusca Census (2).

Localities.

		Geological Strata.	*Records.*
VC. 23	*Oxfordshire.*		
	Stow Woods . . .	O	C
	Banbury and Wychwood .	O	C
VC. 25	*Northamptonshire.*		
	Kettering . . .	L	C
VC. 60	*Lancashire, N.W.*		
	Carnforth . . .	CL	C
	Clitheroe . . .	CL	C
	Easegill Beck, near Greygarth.	CL	C
	Silverdale . . .	CL	C
	Warton Crag, near Carnforth	CL	C
	Windy Scout, near Carnforth	CL	J. W. Jackson
	Yealand Storrs; Yealand Conyers.	CL	C
VC. 62	*Yorkshire, N.E.*		
	Middlesborough . .	NR	Poliński (3)
VC. 64	*Yorkshire, Mid. West.*		
	Reynards Ings Addingham .	MG	C CY.
	Arncliffe	CL	C
	Barden	MG	C
	Bolton Abbey . . .	MG	C
	Buckden Pike (to 1,450 ft.)	GL	C
	Buckden Wood . .	L	C CY
	Burnsall	L	CY
	Deepdale . . .	L	C
	Grassington (to 700 ft.). (Double-mouthed specimen, Mr. Chambers).	L	C CY
	Ilkley	MG	C
	Kettlewell . . .	L	C
	Starbotton . . .	L MG	C
	Threshfield . . .	L	C
VC. 64	*Yorkshire, Mid. West (Malham Dale).*		
	Coniston Cold, near Hellifield (double-mouthed specimen Dean).	CL	Dean
	Eshton	CL	C
	Gordale Scar . . .	L	C
	Malham	L	C CY
	Skipton	L	C

		Geological Strata.	Records.
VC. 64	*Yorkshire, Mid. West (with the Lune and Ribble Vales)*		
	Chapel-le-Dale . .	CL	C
	Clapham . . .	CL MG	C
	Inglebrough (at 2,100 and 2,350 ft.).	CL	C CY
	Ingleton (Dextral specimen, F.R., 1889).	CL	C CY
	Lonsdale (all up the dale) .	CL	Nat. (5)
	Ribblehead (to 1,000 ft.) .	CL	C
	Horton in Ribblesdale .	L	Mrs. Morehouse
	Settle	CL MG	Dean
VC. 65	*Yorkshire, Mid. West (Swaledale).*		
	Great Fencote, near Kirby Fleetham.	MG	C
	Keld (near the top of the dale).	CL	C
	Marske	CL	B. R. Lucas
	Richmond . . .	CL MG	A. T. Lofthouse, G. W. Temperley
VC. 65	*Wensleydale.*		
	Aysgarth (double-mouthed specimen. Lofthouse).	CL	C CY Lofthouse
	Bainbridge . . .	CL	C
	Constable Burton . .	CL	C
	Cotterdale, N.W. of Hawes	CL	C
	Coverdale (to 1,500 ft.) .	CL	C
	Jervaulx Abbey . .	CL	C
	Leyburn Moor . .	MG	CY
	Leyburn Shawl . .	CL	CY
	Masham	CL MG	C
	Hackfall	Mag	C
	Snape	Mag	C
	Wensley	CL MG	C
VC. 65	*N.W. Yorkshire (Teesdale).*		
	Barnard Castle, south bank of R. Tees from Junction of the Greta and Tees to Middleton in Teesdale.	CL	C
	White Force (1,500 ft.), Cronkley Fell.	CL W	N
	Scargill, near Barmingham .	CL	C N
VC. 66	*Durham, Teesdale.*		
	Barnard Castle . .	CL	C
	Eggleston	CL	C N
	High Force . . .	W	C N
	Langdon Beck . . .	CL	C N
	Middleton in Teesdale .	GL L	C N
	Winch Bridge. Middleton in Teesdale.	CL W	C N
	Winston	CL MG	C N
	Whorlton on Tees . .	CL	N

		Geological Strata.	Records.
VC. 66	*Durham, Upper Weardale.*		
	Broadwood, near Lanchester	MG CL	N
	Bollihope Burn . .	GL	N
	Frosterley . . .	GL	N
	Harperley . . .	CL	N
	Newlandside Hall . .	CL	N
	Rogerley Hall, near Stanhope	GL	N
	Shittlehope . . .	GL	N
	Stanhope Unthank Wood .	GL	N
	West Newlands . .	CL	N
	Witton Castle . . .	CL C	N
	Wolsingham . . .	CL	N
VC. 66	*Durham, East Coast.*		
	Blackhall Rocks . .	Mag	N
	Castle Eden Dene . .	Mag	N
	Crimden Bank . . .	Mag	N
	Dawdon, near Seaham Harbour.	Mag	N
	Easington coast to Hawthorn Dene.	Mag	N
	Foxholes Easington Colliery	Mag	N
	Grangetown, Sunderland .	Mag	N
	Hawthorn Dene . .	Mag	N
	Houghton-le-Spring . .	C. Mag	N
	Marsden, near Byers Quarry	Mag	N
	Penshaw	C Mag	N
	Ryhope Dene . . .	Mag	N
	Seaham Dene and Seaham Harbour.	Mag	N
	Shippersea Bay . .	Mag	N
	Tunstall Hill and Quarry .	Mag	N
	West Bolden, Down House	Mag	N
VC. 67	*Northumberland, South.*		
	Aesica Camp (Great Chesters).	W	N
	Borcovicus Camp (Housteads).	W	N
	Chollerton . . .	CL	N
	Errington Hill Head . .	CL	N
	Gunnerton . . .	GL	N
	Halton Shields . .	CL	N
	Kirkhaugh . . .	CL	N
	Limestone Brae, Allendale .	GL	N
	Newcastle - upon - Tyne (neighbourhood).	C	C
	Nine Banks, Allendale .	GL	N
	North Birtley . . .	CL	C
	Pigdon, near Morpeth .	CL W	N
	Slaggyford . . .	L	N
	Homer's Lane, Warden .	CL	N
	Wark (N. Tyne) . .	CL	N
VC. 68	*Northumberland, Cheviotland.*		
	Rugley, near Alnwick . .	W	N

		Geological Strata.	Records.
VC. 69	*Westmorland with Furness District.*		
	Arnside	CL	C
	Augill Castle	CL	Lucas
	Brough under Stainmoor .	CL	C
	Bigland Scar, Holker. .	S	L
	Cark in Cartmel . .	NR	CL
	Clifton, near Penrith .	NR	H. Watson
	Crosby Ravensworth, near Shap.	CL	C
	Overland Lane, Grange over Sands.	CL	C
	Eamont Bridge, Broughton Hall.	NR	H. Watson
	Hayeswater	BV	C
	Humphrey Head, near Grange over Sands.	CL	C
	Kirkby Stephen . .	CL	CY
	Orton Scars	CL	CY
VC. 70	*Cumberland.*		
	Alston	CL	N
	Brampton	NR	C
	Melmerby Low Scar .	CL	C
	Penrith	NR	C
VC. 83	*Scotland, Edinburgh.*		
	Bonaly Glen, near Edinburgh.	B NR	C S W. Evans (2)
VC. 85	*Fife.*		
	Dura Den	B NR	C S W. Evans (2)
VC. 110	*Outer Hebrides.*		
	Tarbert Harris . .	Gn	C S G. H. Harrison
	North Uist	Gn	C S G. H. Harrison
	Geological Records.		
Late Pleistocene	Dog Hole Cave, Warton .		J. W. Jackson (6)
Holocene	Fox Hole Cave, Clapham .		J. W. Jackson (6)

The Localities.

A glance at the list of localities will remind the readers that the general centre of distribution for this mollusk is in the Northern Counties, and here its occurrence is well known and has been closely studied. Some further comment is required with regard to the outlying localities.

The notable feature is the discovery, since this survey was originally

completed, of the presence of the species in the Outer Hebrides. I received by the kind generosity of Professor J. W. Heslop Harrison a batch of shells taken by Dr. G. Heslop Harrison in North Uist and Harris of the Outer Hebrides in the course of the King's College (Durham University) Investigation of the Fauna and Flora of the Inner and Outer Hebrides. Among these were shells thought to be *Clausilia bidentata* Ström of an unusual form. Close investigation, however, showed three of the specimens to be typical examples of *C. cravenensis*.

In order to be quite certain that this was indeed the case a series of three hundred North of England specimens in my own collection was re-examined and compared with the view of making sure the recognition of the difference of the aperture and its armature, so carefully worked out by Polinski (3). Specimens from Amerungen and Zutphen in the Netherlands were selected, as they are similar to the Dover *C. dubia* Drap. and differ from *C. cravenensis* in having a more emphatic but variable armature. The aperture is also smaller, more contracted, and is not white lipped, while the lower palatal callus or swelling has a long and narrow plica directed distinctly inwards, which is never found in *C. cravenensis*. Specimens also were selected of *C. dubia* var. *obsoleta* Ström from the Mid Rhine, from Echternach, in Luxemburg, and Dillenberg Schloss, Hessen, Germany, as they resemble *C. cravenensis* fairly vividly in the sculpture of the surface of the shell and agree with it in some of the characters of the obsoleteness of the aperture armature but differ from it in the plicæ of the columellar wall.

The variation within the long series of *C. cravenensis* examined ranged from an armature somewhat less strongly developed than *C. dubia* to an obsoleteness greater than that of *C. dubia*, with a palatal swelling ranging from a strongly developed triangular hump, to one so weak, as to be almost imperceptible. In *C. dubia*, however, the lower palatal swelling has a narrow plica directed inwardly which is never found in *C. cravenensis*.

The specimens from the Hebrides fall midway within this range and show no features inconsistent with this position.

Another specimen of *Clausilia* was taken in Scalpay (of the Inner Hebrides) having nine whorls, without lip or armature, too immature to record, but already at that time suspected of being *C. cravenensis*. There is, however, no doubt whatever of the specimens from the Outer Hebrides.

There are two old Scottish records, one from Bonaly Glen, near Edinburgh, taken in 1893, another, from Dura Den, Fifeshire, both recorded by W. D. Roebuck. These are unconfirmed in recent years but cannot be ignored.

The Distribution Area and its Geology.

A glance at the list of the Geological strata represented in the habitats of *C. cravenensis* gives a preponderance of limestone rocks with a few definitely not limestone. While this is so, however, several facts must be borne in mind. To begin with many of the old records are not precise in their localities. It is often necessary, particularly in Northumberland, to know the exact locality within a few yards to be certain of the nature of the rocks represented. The term Carboniferous Limestone in this county covers a series of beds in which limestone is only poorly represented ; for this reason, when the locality is known to occur on the thickest band, the Great Limestone, it is so recorded instead of the more general (CL). In certain areas Mountain Limestone, as originally defined, is recorded for seams of pure limestone. Again much of the area involved is covered with Boulder Clay, which may either cover Limestone rocks or, alternatively, provide Limestone Boulders in a lime-free area. The records do not include the Drift. The Basalt of the Whinsill counts as calcareous, since on weathering it liberates calcium carbonate and provides habitats for calcicole plants. Since walls are a favourite habitat of this snail it is sometimes the nature of the walls rather than that of the surrounding strata which is important.

It will be noticed that the main area of distribution is in the rocky mountainous territory of the Carboniferous, Permian, and Triassic formations of North-West Yorkshire, Westmorland, North Lancashire, Cumberland, Durham, and Northumberland, with a few isolated spots in Oxfordshire, Scotland, and the Hebrides.

The absence of the species from East and North Yorkshire, with the exception of Middlesbrough is noticeable. The north-east, at least, has areas not unlike areas in which *C. cravenensis* is found. We might reasonably expect, therefore, to come across traces of its presence in Cleveland valleys, if not on the plateau. Further investigation of these areas, as well as those of Northallerton, Thirsk, and Easingwold, might cast light on its absence or reveal traces of its unsuspected presence. It is a very elusive species in many areas, and needs very careful and patient searching to find it at all.

It will also be noted that a few of the returns are from the Millstone Grit area as, for instance, those from Addingham and Ilkley ; the colonies of the former are referred to by Dean (4) as being dwarfed by adverse conditions. It is well known in Yorkshire that many of the older walls were built of Boulder stones which littered the fields and hills. Many of these are of Limestone and the snails could find the calcium they needed. Other returns are from the New Red Sandstone areas, as at Penrith or near by, where there are,

in places, layers of Brockram Limestone Pebbles. This probably accounts for the presence of this lime-loving species. Lime from old mortar may occasionally be of significance, but it is to be noted that, for all its apparent preference, Professor A. E. Boycott, as also I myself, have found specimens on mortar-free walls of Millstone Grit. Dr. Wilfrid Jackson (6) records abundant and large specimens from Bigland Scar, near Holker, on the Upper Silurian Bannisdale Flags, etc. Boycott records in these patches of calcareous boulder clay which entirely alter their character (7). In the case of the Scottish records of Bonaly Glen and Dura Den, Volcanic Rocks and Limestone Pebbles or Concretions lie on the top of the Old Red Sandstone. In the Hebrides the dunes are often calcareous from old decaying marine shells, while in many of the Isles there are here and there patches of Limestone rocks freeing calcium salts on weathering so the closest investigation of each locality would be necessary to make quite sure that no calcium carbonate was available.

Origin and Routes of Migration.

The view as to the arrival of *Clausilia cravenensis* from the Continent is ably put by the late Dr. Polinśki in his article in the *Journal of Conchology* (3). He suggests that the species arrived in England from the east-south-east by the route of the Rhine, from the mountains of its Middle Region, at a time when the North Sea formed merely a gulf of the North Atlantic and the Rhine had its mouth at the latitude of Yorkshire west of the Dogger Bank. The place of entry would be the mouth of the Tees (see Clement's map in Polinśki's article (3), p. 262. The geological record, one only (of the Late Pleistocene in the Dog Hole Cave, Warton) suggests to him that the entry was in a fairly late phase of the Quaternary and after the Ice Age.

Assuming that the estuary of the R. Tees was the place of entry (and the records decidedly point in that direction) the flow of distribution went up both sides of the valleys of the Tees and its tributaries which give them an open egress into the inner country; on the one hand, it turned westward into the Craven and other valleys of North-West Yorkshire and from thence into Westmorland, Cumberland, and Lancashire; on the other hand, it turned northward into the Pennines, by Upper Weardale, into Cumberland and the south-west of Northumberland. Another flow from the Tees Estuary passed northward along the Durham coast, where there was an open route; turning westward into the Lower Weardale and into Tynedale, and by the Tyne and its tributaries it reached Northumberland. Its entry, judging by its sparse presence there, would appear to be at a somewhat later period.

The eastern limit of distribution is west of a line drawn from Middlesbrough to Ilkley, if the Scarborough record is not accepted.

The southern limit is Ilkley in West Yorkshire and Clitheroe in Lancashire. Dean expresses an opinion (4) that the distribution of *C. suttoni* Westl. would appear to have been more general in the past. He refers to specimens from Stow Woods, Oxford, Collinge's records for Banbury and Wychwood, and Bean's Scarborough specimens, and remarks that it may never be possible to confirm some records, owing to the deforestation of original woods. There is also one record for Kettering. This theory finds some support from the fact that the northern limit of distribution has had to be extended from Rugley, near Alnwick, in Northumberland, to the Outer Hebrides by the recent finding of specimens of *C. cravenensis* in North Uist and Harris. We have, also, the earlier records from Bonaly Glen, near Edinburgh, and Dura Den, in Fife. The record of the widespread dispersal of the species in Northumberland, up to very recent years, was confined to three localities and only bit by bit has the knowledge of its presence been traced elsewhere. The isolated Scottish records may be in like manner precursors of the finding of many more in unexpected places. A theory as to a migration northward across the Tweed is faced with great difficulty in finding a route with open valley passage. An easier route of migration from the south by way of the west coast has much to be said for it. The presence of the southern *Helicella itala*, *Cochlicella acuta*, and the western *Planorbis dilatatus* (10), and of other members of the Southern Fauna and Flora gives some weight to the theory. Against it is the fact that the Hebridean form of *Clausilia* is that of *cravenensis* and not the Dover *dubia*. But if *Planorbis dilatatus* came from Lancashire, where it is fairly common, why could not *C. cravenensis* have also come from Lancashire, where it is also common ?

It seems desirable, however, that the implications of such a distribution as summarized should be looked into and for that purpose the Oxfordshire and Scottish records may be assumed to be sound, since the difference they make is in quantity and not in kind any more.

Discontinuous distribution undoubtedly suggests antiquity and we might consider the evidence for, and against, the possibility of *cravenensis* being a survival from, at least, an Interglacial period.

The negative evidence of its not being known as a fossil earlier than the Late Pleistocene, is not very strong, as the probability of a snail which lives on walls or rocks being fossilized can hardly be great. The Oxfordshire and neighbouring localities are beyond the south limit of all but the maximum glaciation, so would cause no

difficulty with a snail which seems to prefer exposed situations. The area of dense distribution round the Pennines seems somewhat of a mystery, but the actual distribution fits in just as well if we consider the snail as surviving on, for instance, the Nunataks (Raistrick), and migrating downwards, instead of upwards as suggested. The fact that it has its habitats on Ingleborough, Cronkley Fell (Mickle Fell), and Buckden Pike, all of them Nunataks, may be more than coincidence. The Scottish records seem to be a difficulty, but those from the Outer Hebrides can also be explained on the Nunatak basis because Jehu and Craig (9) have shown that the highest peaks on these islands were never covered with ice. If, later on, *cravenensis* should be found on Ben Lawers or one of the mountains of the mainland which stood out above the ice sheets it would prove a welcome support for this hypothesis.

Notes on the Habits and Environment of *C. cravenensis*.

One of the most striking characteristics of *C. cravenensis* is its hardiness. The character of the localities which are its usual habitat, and its habits in general, unmistakably emphasize this fact. In Northumberland it is chiefly found in the bleak region of Hadrian's Wall which runs over high hilltops and inhospitable fells. The snails for the most part frequent stone walls exposed to torrential rains and biting north-east winds. Two of its habitats are in the Roman Wall itself, near Æsica (Great Chesters), and on the excavated ruins of Borcovicus Camp (Housteads). A recent find of the species was made near the upper reaches of a wild pass of West Allendale. Other places of highish altitude, such as Alston, Kirkhaugh, and Slaggyford are equally exposed. In Teesdale and Weardale, again, it loves rough dry stone walls or limestone scarps along windswept dales. In Durham it is found in a long chain of places on the coast line ; at Blackhall Rocks it lives right on the edge of the cliffs, exposed to all the gales and sea spray of that coast. In a few places it is found in the sheltered denes, running seawards, living on limestone crags or on the bridges over the streams.

The species dwells also in similar surroundings on the Yorkshire Pennines and the Cumberland and Westmorland hills, at high altitudes. It has been taken on Ingleborough (2,000 and 2,350 feet), at White Force, Cronkley Fell (1,500 feet), in Coverdale (to 1,500 feet), on Buckden Pike (1,450 feet), and Ribblehead (1,000 feet). This distribution is in striking contrast to the more luxuriant surroundings of sheltered woods, the favourite haunts of *Marpessa laminata*. It is curious that this hardy species, which seems to

prefer a harsher climate, should have, as its outstanding northern outpost, a locality in the Hebrides with a definite oceanic climate. There is, perhaps, a somewhat parallel instance in the Cartmel Peninsula and the mainland opposite, on the other side of the Kent Estuary. Here a genial climate and other very suitable conditions were found to be favourable to prosperous colonies. Alkins (11) reports that in four loci in this area within 165 yards he secured, without difficulty, 560 full grown and well-developed specimens of *cravenensis*, while, a few miles further inward, he took, in three loci, within a quarter of a mile 594 good specimens. He also asserts that in those parts *cravenensis* was almost always with *bidentata* and occasionally with *laminata* also. These favourable surroundings, associations, and great numbers are very exceptional and do not occur farther north. I have only once found the three species living together; twice *bidentata* and *cravenensis* were associated but never *cravenensis* with *laminata*. Usually where one is neither of the other two will be found. In the colder north we have to be content when we can secure a dozen or twenty in number, except in one or two favoured spots in Durham, where the snails are a little more plentiful. The shells also are smaller and less developed. The dwarfing of shell and paucity of numbers may, in part, be due to long exposure to the inclemency of the lengthy winters and springs; it certainly kills off immature snails, at various stages, in great numbers. This spring, in a place where *Balea perversa* was common, a score of dead young ones was found on a wall in a few feet space; a yard or two of area would have produced many more. Boycott (7) asserts that, of mollusca generally, only one of an annual brood of eggs survives as a living snail, and the greatest mortality is in the egg stage. The snails have many and divers foes and none of us know the tale thereof.

Whatever may have been the general environment of *C. cravenensis* in its original continental surroundings this British species, during the long period in which it has differentiated itself and become endemic, has well adapted itself to the hard conditions of its surroundings.

It lives on lichen and minute fungi on walls and mosses and can be easily kept alive in captivity for long periods upon damp lichens and mosses. In winter it appears to hide itself in the earth at the bottom of the walls or crags on which it lives. It does not emerge until late on in spring when the weather is favourable. It may then be found at the base of the wall after very diligent searching.

In conclusion, one effect of inclement conditions should not be omitted, namely that the weather, sun, and wind, have a tendency to produce in several members of the Clausiliidae a strigillation or

bleaching in white flecks or spots, on or below the sutures and a desiccation of the periostracum, varying in different species. Westerlund (12) gives this feature as a characteristic of *C. bidentata* and *C. dubia.* I have examined about 300 specimens of *C. cravenensis* for this feature and have found flecking to be of frequent occurrence in a greater or lesser degree. I found, more recently, in an excellent group of seventy-six specimens from Middleton-in-Teesdale, sent me by Mr. Waterston, that scarcely any were without traces of this streaking.

It was suggested to me that this strigillation might not, after all, be a genetic feature but rather a decay of tissue, like roughness and dryness of skin and greying of hair. I applied a little almond oil on some highly streaked *C. bidentata*, leaving it on for two or three days, and removed all moisture. All the flecking disappeared and left a uniform colour. The colour still remains uniform after some months. It might be worth while to experiment on flecked living specimens.

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NOTES ON *LIMAPONTIA DEPRESSA* (A. & H.) VAR. *PELLUCIDA* KEVAN KEPT UNDER ARTIFICIAL CONDITIONS.

By D. Keith McE. Kevan, B.Sc.

In an endeavour to find a solution to some of the problems noted by Kevan (1, 2) regarding the life-history of this variety, the writer sought to discover the conditions to which it was most suited when kept in captivity, and also to determine whether this race merited specific status. Owing to the war and to pressure of other work, however, investigations did not proceed past the preliminary stages.

Considerable numbers of specimens were collected from Tynninghame Estuary, East Lothian, on 24th December, 1939, and these were distributed in five tanks (a main one and four subsidiary ones) under varying conditions, and fed on *Vaucheria* from the marsh. The main tank, containing the majority of the specimens, was made as " natural " as possible, with mud and algae only partly submerged in water taken from the salt-marsh creeks.[1]

The subsidiary tanks, containing from three to six specimens each, were as follows :—

(*a*) Mud and *Vaucheria* entirely submerged.

(*b*) Moist mud ; little water.

(*c*) Mud high out of water, the sides being vertical.

(*d*) As the main tank, but the three specimens contained were of a heavily pigmented (almost blackish) type—*not* L. capitata.

Specimens in tanks (*b*), (*c*), (*d*) did not survive past the middle of February, 1940, but the main tank and tank (*a*) did well, the latter particularly so, the molluscs increasing considerably in size, probably due to the proportionately larger food supply in the entirely aquatic medium.

The specimens in the main tank tended to decrease conspicuously in size after about 20th April, because by that time they had presumably exhausted the food supply, which it was found impossible to replenish in sufficient quantity. By June all were dead or dying. It is of note that Kevan (1) found no specimens on the marsh in June, and that the surface becomes parched and dried, which would kill off the *Vaucheria* in any case.

In tank (*a*), however, the specimens were still healthy and fairly active, but by the end of July to the beginning of August, although there was sufficient food, they decreased in size and died, tending to prove that by this time they would have normally died off and disappeared from the marsh, and that survival there during the summer months does not occur, as indicated by Kevan (1).

[1] The salinity of the water in the creeks at the time of collection was not appreciably different from that of ordinary Firth of Forth sea water.

It would appear that a totally submerged habitat is preferred by the variety when kept under artificial conditions, similar to the natural habitat of the Type (3), although this is not the case in its Tynninghame environment. This and the fact that egg-capsules laid in captivity [2] (main tank at end of January, and tank (*a*) at end of February) were only *below* water—as opposed to the Tynninghame environment—would suggest that this variety has no claim to specific status although remaining a very distinct biological race.

Another fact tending to corroborate this conclusion is that the specimens in tank (*d*) were heavily pigmented and that they seemed to vary in intensity of pigment, eventually becoming somewhat lighter and more like the other specimens, though still remaining dark. The reason for this change is doubtful. These dark forms are rare.

(N.B.—No material of the Type being available, anatomical investigation was not carried out.)

L. capitata also occurs at Tynninghame (1), and it is worthy of note that it also has a paler variety (4, 5), though this is not found at Tynninghame.

The facts indicated by the above notes are (*a*) that *Limapontia depressa pellucida* is probably not a distinct species, though differing in many respects from the Type, and (*b*) that it is most probably absent from the marsh during the summer months, survival being as veligers and young in the Estuary proper, or less probably in the creeks.

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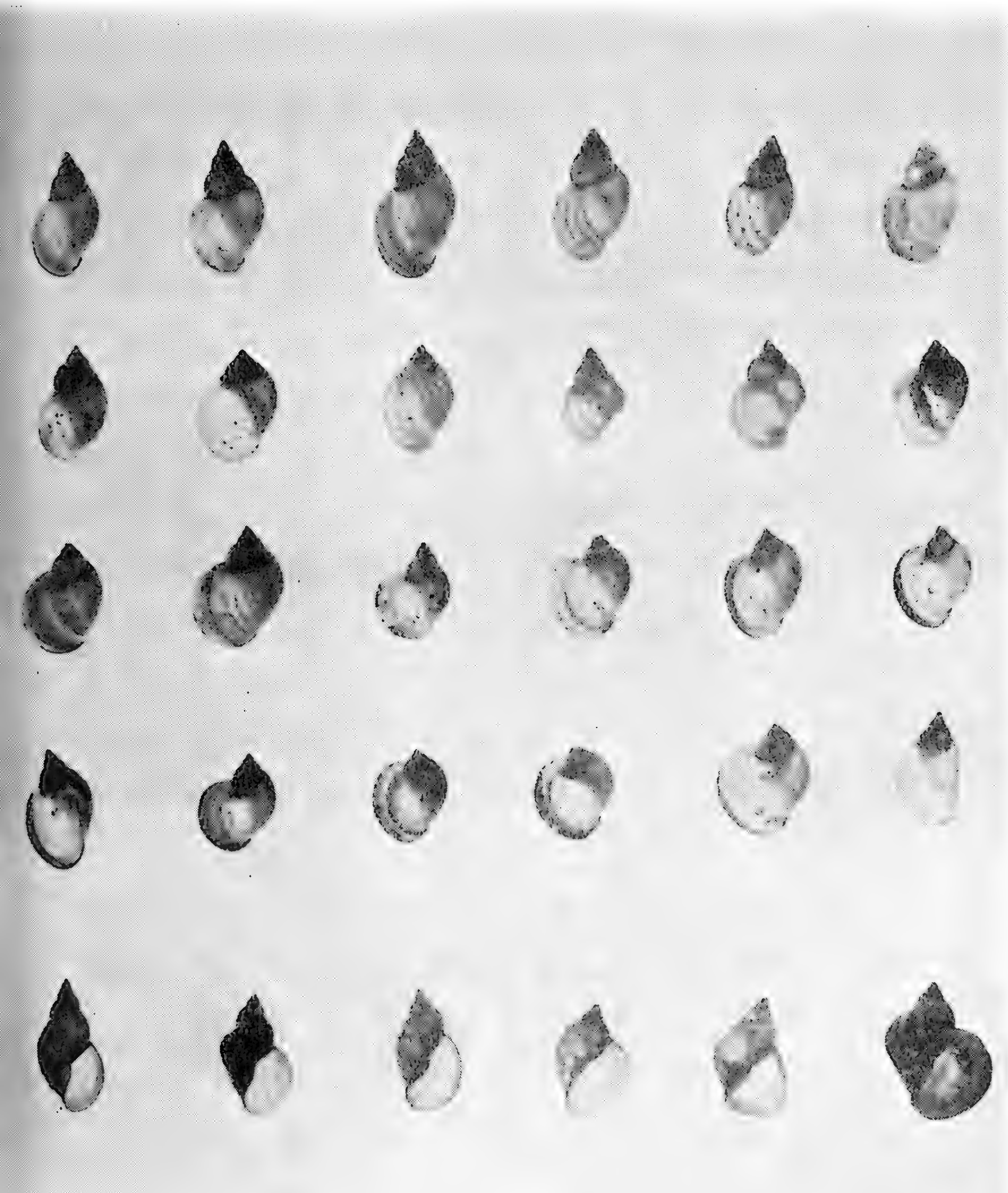
LYMNAEA (*STAGNICOLA*) *CATASCOPIUM* SAY.

By D. KEITH McE. KEVAN, B.Sc.

I GIVE here a photograph of a series of this shell from Leith as recorded in the last number, p. 279. The Leith specimens have on the whole the aspect of the form *pinguis* Say rather than of the type.

[2] Veligers did not survive and did not emerge.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PISIDIA OF LANCASHIRE AND CHESHIRE.

By J. Wilfrid Jackson, D.Sc., F.S.A., F.G.S.

(Read before the Society, 23rd May, 1941.)

The following account deals with the Pisidia of Lancashire and Cheshire so far as is known. The recent publication by Mr. A. E. Ellis of his paper on "The Identification of the British Species of Pisidium"[1] has led me to look up an accumulation of notes on this group of freshwater bivalves. Several of my locality sets were sorted out and named by the late B. B. Woodward when he was engaged upon his Catalogue of the British Species of Pisidium (Recent and Fossil), British Museum (Nat. Hist.), 1913. Later, in 1918, the whole consignment, some 106 sets, was submitted to Messrs. A. W. Stelfox, C. Oldham, and R. A. Phillips, and many corrections were made. I am much indebted to these authorities for the very many valuable notes made on the collection. I am further indebted to Mr. C. Oldham for so kindly lending me his catalogues of the Pisidia in his collection. I have made many extracts from these books.

In conformity with the Census of the Distribution of the British Land and Freshwater Mollusca,[2] the Pisidia records are divided into Cheshire, Lancashire South and Lancashire West. The few records for Lancashire North (i.e. north and west of Morecambe Bay) are not included, as they go more naturally with Westmorland.

The first records of Pisidia for the two counties are contained in a paper by Joseph Kenyon, in 1829,[3] who gives *Cyclas obliqua* (now known as *Pisidium amnicum*) and *C. fontinalis*, for Preston, Lancashire. The latter species is probably *Pisidium cinereum*, as we find E. J. Lowe, in 1853,[4] referring to that species at Preston. David Dyson, in 1850,[5] refers to four species, viz. *P. obtusale*, *amnicum*, *henslowianum* and *pusillum*. It is of some interest to note that the Rev. Leonard Jenyns himself[6] cites *Pisidium pusillum* from Preston Moor (coll. Mr. Gilbertson). Scattered references to Pisidia occur in the literature of later years, many of which are cited for Lancashire in my "Bibliography of the Non-Marine Mollusca of Lancashire" in 1907.[7]

In Robert Standen's 1887 Lancashire list[8] eight species of Pisidia are mentioned and some of these are given as varieties of others.

[1] Ellis, *Proc. Malac. Soc.*, vol. 24, July, 1940, pp. 44–88.
[2] *Journ. Conch.*, vol. 16, 1921, pp. 165–212.
[3] *Mag. Nat. Hist.*, ii, 1829, p. 273.
[4] *The Conchology of Nottingham*, 1853.
[5] The Land and Freshwater Shells of the Districts around Manchester.
[6] *Ann. Mag. Nat. Hist.*, 1858, pp. 104–7.
[7] *Journ. Conch.*, April, 1907, pp. 53, etc.
[8] *Naturalist*, May–June, 1887, pp. 155–176.

The list is as follows: *Pisidium amnicum* (Müller); *fontinale* (Drap.) and vars. *henslowana* Shep., *pulchella* Jen. and *cinerea* Alder; *pusillum* Gmel.; *nitidum* Jen., and var. *globosa* Jeff.

The first full list of Cheshire Land and Freshwater Mollusca is that of C. Oldham in 1896.[9] In this nine species are listed, viz. *Pisidium amnicum* (Müll.); *fontinale* (Drap.) and var. *cinerea* Alder; *henslowanum* (Shep.); *pulchellum* Jenyns; *pusillum* (Gmel.) and var. *obtusalis* (Lam.); *nitidum* Jen.; and *milium* Held. This list was supplemented in 1908[10] by additional records of localities for four species.

In the late '60's and early '70's Thomas Rogers, of Manchester, was in close correspondence with J. Gwyn Jeffreys, and the latter named for him *Planorbis dilatatus* from canals at Pendleton and Gorton, Lancashire (found in June, 1869, by T. Rogers): also "*Hyalinia glabra*" from Marple Wood, Cheshire (found in 1869 by T. Rogers). Rogers seemed to refer all his finds to Jeffreys and in this way had certain of his Pisidia named "*Pisidium nitidum* var. *globosa* J. G. Jeff. (new)" and "*Pisidium pusillum* large variety J. G. Jeff.". Both were from a ditch at Swinton, Lancashire (coll. about 1874). Rogers appears to have sent specimens of each in exchange to numerous correspondents, and a study of these various sets has been instrumental in arriving at their correct identification. The set of "*Pisidium nitidum* var. *globosa*" given to my father-in-law, Robert Standen, proves to comprise *Pisidium casertanum* and *P. obtusale* (very tumid). Similarly, those given to J. W. Taylor and L. E. Adams prove to be *P. obtusale*, with one example of *P. nitidum* in one set. It is of interest to note that a specimen of this form from Swinton was named for J. W. Taylor by Bourguignat, in 1891, as *P. obtusale* C. Pfr. The sets of "*Pisidium pusillum* large variety J. G. Jeff." (i.e. var. *grandis* L. E. Adams) given to R. Standen, J. W. Taylor, and others consist of typical *P. cinereum* (= *casertanum*). Specimens were figured by Woodward in his 1913 Catalogue.[11]

One of the most interesting localities mentioned in the following pages is that of Haweswater, Silverdale, Lancashire. This is a tarn of some twelve acres in extent lying to the north of Silverdale Station on the Furness Railway. It is situated in a somewhat bath-shaped depression in the Mountain Limestone, and is well below the 25 feet contour, the bottom being below sea-level. The water is hard. Surrounding the tarn and at its bottom is a thick deposit of

[9] *Naturalist*, April, 1896, pp. 109–128.
[10] *Naturalist*, July, 1908, pp. 253–261.
[11] Woodward, op. cit., 1913, plate 13, figs. 2*a*, *b* and 12; plate 15, figs. 12*a*, *b*.

chara and shell marl, pointing to a much greater extent of its waters at an earlier time. At the north-east the large tarn is connected by a narrow drain with a small pool known as Little Haweswater.[12] The two tarns and connecting drain contain an interesting series of Pisidia, at least seven species, including a small oval form of *Pisidium hibernicum* Westerlund, with very incurved lateral teeth, and *P. lilljeborgi* Clessin of large size, reaching $5 \cdot 5 \times 4 \cdot 5 \times 3 \cdot 75$ mm. My original specimens of the latter from here were named and recorded in 1905 as *P. nitidum* var. *splendens* Baudon.[13]

List of Species.

Pisidium amnicum (Müller).

Lancs. W.: Kendal canal, Borwick, near Carnforth (C.O., 19.6.20).
Lancaster canal, at Lancaster (J. W. J., 7.03); between Barton and Brock (J. W. J., 4.6.14); between Lea Road and Salwick (W. H. D., 1918); Woodplumpton (R. S., 1887).
River Lune, Caton above Lancaster (Dyson, 1850; R. S., 1887; J. W. J., 1903).
Ponds at Grimsargh and Fulwood, near Preston (R. S., 1887).
Preston (as *Cyclas obliqua*; Joseph Kenyon, 1829. The earliest reference to the species in Lancashire).

Lancs. S.: River Calder, Pendle Bridge, and canal at Burnley (Long, 1901).
Canal at Tarleton (W. H. H., 1886; R. S., 1887).
Bolton canal Clifton Junction to Ringley (R. S., 1887; J. W. J., 1903; W. H. D., 1922). Specimens from this canal, coll. T. R., are figured by Woodward, 1913, pl. v, figs. 3*a*, *b* and 14.
Pond near Astley Station, Chat Moss (W. H. D., 1917).
Bridgwater canal, especially at Booths Hall Bridge, Boothstown (W. H. D., 1922).
Canals at Droylsden (J. W. J., 1915); Bardsley (E. C., 1885; F. T., 1898; J. W. J., 1903); Hollinwood (C. O., 1888).
Canal at Reddish (Hardy, 1865; Alkins, 1918).
Canal at Stalybridge (Hardy, 1865).
Overflow of River Mersey, near Stretford (Hardy, 1865).

[12] Jackson, *Lancs. and Chesh. Naturalist*, July–August, 1914, pp. 135–140 and 197–201.
[13] Jackson, *Journ. Conch.*, vol. xi, 1905, p. 170.

Dallam Brook, Little Sankey, near Warrington (Dyson, 1850).
Debris of River Alt (Grensted, 1922).
Canal at Litherland, near Bootle (J. Gibson, *Liverpool Nat. Scrap Book*, 1863, p. 126; also Higgins, 1891).
Ditches on moss and Martin Mere Road beyond Churchtown; also very fine in canal at Burscough Bridge (McNicoll, also Chaster, 1892).
Southport (Chaster, 1903); and in second drain beyond Kew Gardens (Chaster, 1892).

Cheshire: River Dee, Eccleston Ferry (C. O., 1920).
Canal at Chester (C. O., 1896).
Blacon Point, near Chester (Bellars).
Streams near Chester (B. T., see C. O., 1896 list).
Tarvin (B. R. L., see C. O., 1908 list).
Canal near Beeston Castle (C. O., 1900 and 1920).
Canal at Bickley (C. O., 1894).
Marbury Mere, Northwich (B. R. L., 1917).
Canal at Lostock Gralam (C. O., 1896 list).
Canal at Middlewich (C. O., 1908 list).
Stream, Brooklands (C. O., 1890).
Mobberley (C. O., 1896 list).
Rostherne Brook (C. O., J. G. K. and W. H. D., 1918).
Rostherne Mere, south end (W. H. T., 1914); off Harpers Bank, 3–5 feet, sand (W. H. T., 1914); Blackburn's Brook, the outlet of the mere (J. W. J., 1921).
River Birkin (C. O., 1896 list).
Caldwell Brook (C. O., 1896 list).
Canal, Congleton, var. *flavescens* (E. C., see *Journ. Conch.*, vol. iv, p. 153).
Canal, High Lane (J. W. J., 1903).
Canal from Hyde to Whaley Bridge (C. O., 1896 list; Cartwright, 1919; especially common at Marple (F. T., 1910; J. W. J., 1915); var. *flavescens* at New Mills (C. O., 1895).
Canal at Dukinfield (F. T., 1909).

Pisidium cinereum Alder. (*casertanum* Poli, B. B. W. and auctt.).

Lancs. W.: Haweswater (J. W. J., 1904; C. O., 1920).
Pond, Woodwell, Silverdale (small oval form, J. W. J., 1909).
Dog Holes Cave, Warton Crag (Pleistocene, J. W. J.).
Ditch, Burrow Height, Lancaster (still water form, J. D. D., 1906).

Ditch, Scotforth, near Lancaster (J. D. D., 1906; referred to *personatum* by Woodward, 1913, p. 56).

Lancaster (A. S. K. See Woodward, 1913, pl. 13, figs. 6*a*, *b* and 22; pl. 16, figs. 11*a*, *b*).

Ansdell (W. H. D.).

Grimsargh, near Preston (W. H. H.).

Lancs. S.: Drains, Woodville, near Southport (R. S., 1887; as *nitidum*).

Ainsdale (J. W. J.).

Brook, near Botanic Gardens, Churchtown, Southport (J. W. J., 1911).

Ditch between Melling and Aintree; ditch, Formby; pool in sandhills, Hightown; ditch, Cook's Lane, Little Crosby; stream between Crosby and Litherland (Grensted, 1923).

Stanley, near Liverpool (W. J. F., 1890).

Stream and lower lodge, White Coppice; stream, Astley Park, Chorley (Grensted, 1922).

Canal, Aintree (W. H. H.).

Canal, Monton (W. H. D., 1917).

Ditch, Swinton (T. R., 1874; R. S., 1887; originally recorded as *P. pusillum* large var. J. G. J. or *P. pusillum* var. *globosa* L. E. A. See Woodward, 1913, pl. 13, figs. 2*a*, *b* and 12; pl. 15, figs. 12*a*, *b*. Woodward also figures *P. fontinale* var. *cinereum*, T.R. coll., pl. 13, fig. 10; pl. 15, figs. 10*a*, *b*).

Pond, Little Moss, near Droylsden (J. W. J., 1902).

Canal, Droylsden (approaching var. *humeriforme*. J. W. J., 1915).

Pond, near Sportsman's Arms, Fitton Hill, near Oldham (F. T. and J. W. J., 1910; F. T., 1918–19; a specimen from this locality in C. O. coll. measures 7 × 6 × 4 mm. See Woodward, 1913, pl. 13, figs. 1*a*, *b* and 13; pl. 15, figs. 6*a*, *b*, as *pusillum* var. *grandis*, T. R. coll. A specimen in F. T. coll. 1899, was referred to *intermedium* Gassies by Stelfox and Phillips in December, 1918).

Warm water mill lodge, Waterhead, Oldham (F. T., 1917).

Pond, Higher Tonge, Middleton (F. T., 1918).

Canal at Cavendish Mill, Ashton-under-Lyne (F. T., 1918).

Manchester (A. S. K. See Woodward, 1913, pl. 13,

fig. 9 ; pl. 15, figs. 11*a*, *b*, "*fontinale* var. *rosea* Scholtz" from Boettger).
Ditch, Withington, Manchester (L. W. G., 1922).
Ditch off Hardy Lane, Chorlton, Manchester (J. W. J., 1915).
Pond, Hough End Clough, Manchester, S. (J. W. J., 1915).

Cheshire : Birkenhead (J. R. le B. T.).
River Dee, Eccleston Ferry (C. O., 1920).
Swampy ground, Heswall (C. O., 1894).
Canal, Beeston Castle (C. O., 1920).
Pond, Kelsall (C. O., 1894, a trigonal form referred to *supinum* by Woodward).
Hatchmere, Delamere Forest (C. O., 1920).
Brook, Lostock Gralam (C. O., 1892).
Ditch, Marston, near Northwich (C. O., 1892).
Marbury Mere, Northwich (B. R. L., 1917, some more or less referable to var. *humeriforme*, *fide* A. W. S.).
Ditch, Ashton-on-Mersey (C. O., 1893).
Ditch, Brooklands (C. O., 1890).
Pond, Northen Etchells (C. O., 1892).
Pond, north of Baguley Hall (J. W. J., 1903, approaching var. *ponderosa*).
Rostherne Mere ; off Harper's Bank (W. M. T., 1914), shore off boathouse, etc. (W. M. T., 1912), runnel in Mere Covert (J. W. J., 1921), Gale Bog (J. W. J., 1921), Blackburn's Brook (J. W. J., 1921).
Marshy spot, Mobberley (C. O., 1893).
Pond, Fulshaw, near Wilmslow (C. O., 1899).
Pond, Chelford (C. O., 1894).
Ditch, Romiley (C. O., 1895).
Pond, near Marple Hall (J. W. J., 1902).
Canal, Marple (F. T., 1910 ; referred to *supinum* by Woodward, but Stelfox and Phillips agree that they are trigonal forms of *casertanum*).
Canal, Marple (J. W. J., 1915, referable to var. *humeriforme*).
Pond, Lyme Park (C. O., 1895).

Pisidium personatum (Malm).

Lancs. W. : Pond, Woodwell, Silverdale (J. W. J., 1909).
Pool, near Haweswater, Silverdale (J. W. J., 1904).

Lancaster (A. S. K. Figured by Woodward, 1913, pl. 20, figs. 5, 16, 25, as "*nitidum* var. *splendens*").
Scotforth, near Lancaster (J. D. D., 1906; C. O., size 4·75 × 4 × 3 mm.).
Lytham (L. E. A.); pond, Lytham (R. S., 1886).
Ansdell (W. H. H. and W. H. D., 1917).
Dyke, Little Marton, Blackpool (E. Dearing, 1936).
Grimsargh, near Preston (W. H. H.).

Lancs. S.: Southport (T. R.).
Pond, Ainsdale (J. W. J).
Ditch, Grange Lane, Longton (W. H. H. and W. H. D., 1919).
Cuerdale, near Preston (W. H. H.).
Farrington, near Preston (W. H. H.).
Canal, Tarleton (W. H. H.).
Stream, Astley Park, Chorley (Grensted, 1922).
Ditch between Melling and Aintree; ditch, Formby; pool in sandhills, Hightown; ditch, Cook's Lane, Little Crosby; stream between Crosby and Litherland (Grensted, 1923).
Canal, Aintree (W. H. H.).
Pond, Higher Tonge, Middleton (F. T., 1918).
Oldham Park, Oldham (F. T., 1918).
Fitton Hill, near Oldham (F. T., 1918–19; see Woodward, 1913, pl. 20, figs. 1, 28).
Ashton-under-Lyne (C. O.).
Pond, Swinton Fields, Swinton (C. O., A. S. K., W. H. D., 1917).
Ditch, Withington, Manchester, S. (Grensted, 1922).
Ditch, off Hardy Lane, Chorlton, Manchester (J. W. J., 1915).
Pond, Hough End Clough, Manchester, S. (J. W. J., 1915).

Cheshire: Pool, Dibbinsdale, Bromborough (N. F. McM. and R. M., 1938).
Mouldsworth (A. S. K.).
Ditch, Northenden (C. O., 1890, olim *pusillum*).
Marshy ground near Baguley Hall (C. O., 1892, olim *pusillum*).
Bramhall (C. H. M.).
Rostherne Mere, shore (W. M. T., 1912); off boathouse (W. M. T., 1912); runnel in Mere Covert (J. W. J., 1921); Gale Bog (J. W. J., 1921).

Pond, Romiley (C. O., 1895, olim *pusillum* and *nitidum*).
Pond near Marple Hall (J. W. J., 1902).

Pisidium obtusale (Lam.) Jenyns (= *obtusalastrum* Woodward).

Lancs. W.: Haweswater, Silverdale (J. W. J., 1904 and 1909; also Holocene).
Pool, east side of Haweswater, Silverdale (J. W. J., 1904; olim *subtruncatum* round form; also oval form; all from peaty water).
Pond, Lytham (R. S., 1886, olim *nitidum*; see Woodward, pl. 30, fig. 15; size 3·7 × 3·3 × 3·4 mm.).
Ansdell near Lytham (W. H. H.).
Ainsdale (J. W. J.).
Brook near Botanic Gardens, Churchtown, Southport (J. W. J., 1911).
Hesketh Bank, near Southport (B. B. W., 1917).
Crossens (W. H. H.).
Ditch, Cook's Lane, Little Crosby (Grensted, 1923).
Liverpool (H. O.).
Pond, Parkbridge, Ashton-under-Lyne (R. Cairns, erroneously referred to *personatum*, see Woodward, 1913, p. 57).
Oldham (B. T., see Ellis, 1940, pl. 5, fig. 38).
Fitton Hill, near Oldham (J. W. J., 1902, olim *pusillum*).
Swinton (R. S., 1887, as *nitidum* var. *globosa*, T. R. coll., see Woodward, 1913, pl. 30, figs. 5, 19).
Ditch at Agecroft (W. H. D., 1917).
Pond, Reddish (F. T., 1918).

Cheshire: Birkenhead (E. R. S.).
Helsby (B. B. W.).
Chester (B. B. W.).
Pond, Kelsall (C. O., 1920).
Oakmere (C. O., 1894).
Pickmere (C. O., 1894).
Pond, Brines Brow, Mouldsworth (C. O., 1902, olim *nitidum*).
Pond, Pavement Lane, Mobberley (C. O., 1902, olim *nitidum*).
Pond, Ringway (C. O., 1890, olim *nitidum*).
Rostherne Mere, outlet brook (W. M. T., 1912); Gale Bog (J. W. J., 1921).
Old pitstead, Baguley Hall (C. O., 1892, olim *nitidum*).
Baguley Moor (C. O., 1894, olim *fontinale*).
Pond near Marple Hall (J. W. J., 1902).

Millbrook, Stalybridge (C. H. M., 1903; F. T., 1909, olim *nitidum*).

Pisidium milium Held.

Lancs. W.: Haweswater, Silverdale (J. W. J., 1904, 1909, also Holocene).
Ditch, Haweswater, Silverdale (J. W. J., 1904; C. O., 1920).
Ansdell (W. H. D., 1917).
Newsham and Grimsargh, near Preston (W. H. H.).

Lancs. S.: Pond, Samlesbury, near Preston (J. Smith, 1917).
Stream, Astley Park, Chorley (Grensted, 1922).
Pond, Old Grange Wood, Hutton (W. H. H. and W. H. D., 1919).
Canal, Aintree (W. H. H.).
Ditch between Hightown and Sefton; ditch, Cook's Lane, Little Crosby (Grensted, 1923).
Near Liverpool (W. J. Farrer, 1890).
Pond, Fitton Hill, near Oldham (J. W. J., 1902; F. T., 1918).
Pond near Bardsley (J. W. J., 1901; F. T., 1909).
Pond, Higher Tonge, Middleton (F. T., 1918).
Canal, Droylsden (F. T., 1918).
Canal and pond, Reddish (F. T., 1918).
Ditch at Agecroft (W. H. D., 1917).
Canal at Monton (W. H. D., 1917).
Pond, Swinton Fields (W. H. D., 1917).
Prestwich (W. H. H.).
Pond, Hough End Clough, Manchester, S. (J. W. J., 1915).
Ditch, near Jackson's Boat, Chorlton, Manchester (J. W. J., 1915).
Ditch off Hardy Lane, Chorlton, Manchester (J. W. J., 1915).

Cheshire: Near Birkenhead (P. R. Shaw, 1890).
Heswall (C. O.).
Parkgate (C. O.).
Oxton (W. J. F.).
Pond, No Man's Heath, Malpas (C. O., 1894).
Pond, Kelsall (C. O., 1894).
Mouldsworth (C. O.).
Hatchmere, Delamere Forest (C. O., 1920).
Marbury Mere, Northwich (B. R. L., 1917).
Budworth Mere (C. O.).

Plumbley ; Tabley Pool (C. O., 1903).
Knutsford ; Mere (C. O.).
Rostherne Mere, Harper's Bank (W. M. T., 1914) ; shore (W. M. T., 1912) ; off Mason's Field (W. M. T., 1914) ; Gale Bog (J. W. J., 1921).
Pond, Ashley (C. O., 1894).
Dean Row, Wilmslow (C. O., 1899 ; size $3 \cdot 75 \times 3 \times 2 \cdot 25$ mm. olim *pusillum*).
Running ditch, The Carrs, Wilmslow (Grensted, 1925).
Pond, Alderley Edge (C. O., 1898).
Ditch, Baguley Moor (C. O., 1894).
Pond, Baguley Moor (J. W. J., 1902).
Hampson's Pit, Baguley (C. O., 1892 ; see Woodward, 1913, pl. 29, fig. 27).
Pond, Northen Etchells (C. O., 1892).
Pond, Adlington (C. O., 1893).
Poynton (C. O.).
Pond, Romiley (C. O., 1895).
Marple Park (C. O.).
Pond, Bredbury (C. O., 1895).
Canal Dukinfield (J. W. J. and F. T., 1909).
Millbrook, Stalybridge (F. T., 1909).

Pisidium subtruncatum Malm.

Lancs. W. : Canal, Borwick, near Carnforth (C. O., 1920).
Haweswater, Silverdale (J. W. J., 1904 and 1909).
Connecting ditch, Haweswater, Silverdale (C. O., 1920).
Pond, Woodwell, Silverdale (J. W. J., 1909).
Grimsargh, near Preston (W. H. H., 1919).
Ansdell, near Lytham (W. H. D., 1917).
Canal, Tarleton (J. W. J., thick form).

Lancs. S. : Stream and lake, Astley Park ; lower lodge, White Coppice, Chorley (Grensted, 1922).
Pond, Middle Grange, Hutton (W. H. H. and W. H. D., 1919).
Southport (T. R., L. E. A., E. R. S.).
Moat, Arley Hall, Wigan (W. H. H., 1918).
Waterhead, Oldham (W. H. D.).
Denshaw, near Oldham (F. T., 1910).
Canal, Bardsley (F. T., 1915).
Canal, Droylsden (J. W. J., 1915 ; F. T., 1918).
Pond, Little Moss, near Droylsden (J. W. J., 1902 ; very strongly grooved).

Canal, Guide Bridge (J. W. J., 1903).
Canal, Reddish (W. H. D., 1917).
Pond, Reddish (F. T., 1918).
Pond, Birch, Manchester (R. S., 1887, 1890).
Pond, Hough End Clough, Manchester, S. (J. W. J., 1915).
Ditch, Jackson's Boat, Chorlton, Manchester (J. W. J., 1915).
Canal, Monton (W. H. D., 1917).
Ditches, between Hightown and Sefton; ditch between Melling and Aintree (Grensted, 1923).

Cheshire: Birkenhead (L. E. A. and E. R. S.).
River Dee, Eccleston Ferry (C. O., 1920).
Canal, near Bickley (C. O., 1894; olim *fontinale*).
Canal, Beeston Castle (C. O., 1920).
Hatchmere, Delamere Forest (C. O., 1920).
Marbury Mere, Northwich (B. R. L., 1917).
Pickmere, near Northwich (C. O., 1894; olim *fontinale*).
Pond, Mere Heath Lane, Knutsford (C. O., 1901; olim *fontinale*).
Rostherne Mere (W. M. T., 1912), Gale Bog and Blackburn's Brook (J. W. J., 1921).
Pond north of Baguley Hall (J. W. J., 1903).
Hampson's Pit, Baguley (C. O., 1892, 1894).
Pond, Baguley Moor (J. W. J., 1902).
Ditch, Baguley Moor (C. O., 1892, 1894; olim *fontinale*).
Baguley (C. O., size $4 \times 3 \times 2{\cdot}25$ mm.).
Ditch, Sale Meadows (C. O., 1892).
Running ditch, The Carrs, Wilmslow (Grensted, 1925).
Pond, Chelford (C. O., 1894; olim *fontinale*).
Pond, Mottram St. Andrews (C. O., 1899; olim *fontinale*).
Canal, Dukinfield (F. T., 1900).
Canal, Marple (J. W. J., 1915; thickened form).

Pisidium supinum Schmidt.

Lancs. S.: Canal, Melling (Grensted, 1923).
Canal, Rufford (Chaster; fide A. W. S.).
Pond, Birch Fields, Manchester, S. (R. S., 1887; olim *henslowanum*: see Jackson, *Lancs. and Chesh. Nat.*, 1915, p. 67).

Cheshire: River Dee, Eccleston Ferry (C. O., 1920).
Pond at Kelsall (C. O.). (This is probably *casertanum*).

Canal, Beeston Castle (C. O., 1920; some typical, others near *henslowanum*).
Budworth Mere (A. S. K., size $4 \cdot 2 \times 2 \cdot 5 \times 3 \cdot 4$ mm., see Woodward, 1913, pl. 26, fig. 11). (See also under *henslowanum*, Marbury Mere).

Pisidium henslowanum (Sheppard).

Lancs. W.: Canal, Borwick, near Carnforth (C. O., 1920; one shell inappendiculate).
Canal, Lancaster (J. W. J., 1903; practically inappendiculate).
Canal, Barton, near Preston (J. W. J., 1914; typical).
Canal between Lea Road and Salwick, near Preston (W. H. D., 1918).

Lancs. S.: Canal, Tarleton (W. H. H. and J. W. J.).
Penwortham (W. H. H.; inappendiculate).
Farrington (W. H. H.).
Rufford (W. H. H.).
Crossens (W. H. H.).
Canal, Melling (Grensted, 1923).
Arley Hall, near Wigan (W. H. H., 1919).
Canal, Bardsley (F. T., 1913).
Canal, Droylsden (F. T., 1914; J. W. J., 1915).
Canal, Reddish (W. H. H., 1918).
Brook, Swinton (R. S., 1887; inappendiculate).

Cheshire: Near Birkenhead (P. R. Shaw, 1890).
River Dee, Eccleston Ferry (C. O., 1920).
Canal, Beeston Castle (C. O., 1920).
Canal, Bickley, near Malpas (C. O., 1894).
Marbury Mere, Northwich (B. R. L., 1917; C. O., 1918; some approaching *supinum*, fide A. W. S. and R. A. P.).
Pond at Mere (C. O., 1893).
Pond, Baguley Moor (J. W. J., 1902).
Hampson's Pit, Baguley (C. O., 1886; size $6 \times 5 \times 4$ mm., see Woodward, 1913, pl. 23, fig. 28).
Pond, Brooklands (C. O., 1892).
Pond, Heyhead, Ringway (C. O., 1890).
Ringway (C. O.; figured Ellis, 1940, text-fig. 16).
Rostherne Mere, off Harper's Bank (W. M. T., 1914), dredged near in (W. M. T., 1912), Gale Bog and Blackburn's Brook (J. W. J., 1921).
Printworks Reservoir, Handforth (C. O., 1887).
Canal, Marple (C. O. and J. W. J., 1915).

Pisidium lilljeborgi Clessin.

Lancs. W.: Haweswater, Silverdale (J. W. J., 1904, 1909; C. O., 1920; also Holocene, J. W. J., 1904. My largest recent example measures $5 \cdot 5 \times 4 \cdot 5 \times 3 \cdot 75$ mm. i.e. larger than any mentioned by Woodward and Ellis. A specimen from this locality is figured by Woodward, 1913, pl. 23, figs. 2 and 18*a*, *b*).

Connecting ditch, Haweswater, Silverdale (J. W. J., 1904. My original specimens from here were named and recorded as *P. nitidum* var. *splendens* Baudon, see Jackson, *Journ. Conch.*, vol. xi, 1905, p. 170).

Pisidium hibernicum Westerlund.

Lancs. W.: Haweswater, Silverdale (J. W. J., 1904; also Holocene. One pair of valves has practically straight laterals and extraordinarily short cardinals; fide A. W. S.).

Connecting ditch, Haweswater, Silverdale (J. W. J., 1904, 1909; a little oval form with very "incurved" laterals; fide A. W. S. Also C. O., 1920).

Little Haweswater, Silverdale, 2 feet down, under peat (J. W. J., 1904).

Re above, see Phillips and Stelfox, *Irish Naturalist*, 1918, pp. 39–49.

Lancs. S.: Canal at Reddish (F. T., 1918; see Woodward, *Proc. Malac. Soc.*, 1921, p. 216).

Lower Lodge, White Coppice, Chorley, and lake in Astley Park, Chorley (Grensted, 1922).

Cheshire: Pond, Baguley Moor (C. O., 1894; J. W. J., 1902, three pairs with very long C 3 in largest shell. See Phillips and Stelfox, *Irish Nat.*, 1918, p. 48, pl. ii, figs. 11, 12, and Woodward, *Proc. Malac. Soc.*, 1921, pp. 215–18).

Ditch, Baguley Moor (C. O., 1894; olim *pusillum* var. *obtusalis*. Catalogued by Woodward, 1913, p. 55, as *personatum*. He later agreed with Stelfox that the shells were *hibernicum*).

Rostherne Mere, shore (W. M. T., 1912), Blackburn's Brook (J. W. J., 1921).

Pisidium nitidum Jenyns. (= *pusillum* Woodward, 1913, p. 60; *pusillulum* Woodward, 1921, p. 219).

Lancs. W.: Haweswater, Silverdale (J. W. J., 1904, 1909; also Holocene, J. W. J., 1904. Latter like the form of

nitidum in upper marl beds and peat at White Bog, Killough, co. Down ; fide Stelfox, April, 1920).

Little Haweswater, Silverdale, 2 feet down, under peat (J. W. J., 1904).

Connecting ditch, Haweswater, Silverdale (J. W. J. and C. O., 1920).

Canal, Borwick, near Carnforth (C. O., 1920).

Dog Holes cave, Warton Crag, near Carnforth (J. W. J., Late Pleistocene).

Canal, Lancaster (J. W. J., 1903, olim *pusillum*).

Newsham and Grimsargh, near Preston (W. H. H.).

Ansdell, near Lytham (W. H. D.).

Lytham (L. E. A.).

Lancs. S. : Farrington (W. H. H.).

Canal, Tarleton (J. W. J., olim *pusillum*).

Southport (L. E. A. and E. R. S.).

Moat at Arley Hall, Wigan (W. H. H., 1918).

Pond near Bardsley (J. W. J., 1901).

Canal, Droylsden (J. W. J., 1915, var. *crassa* ; F. T., 1918).

Canal, Guide Bridge (J. W. J., 1903).

Pond and canal, Reddish (F. T., 1918).

Canal, Monton (W. H. D., 1917).

Lake, Astley Park, and pond, Common Bank, Chorley (Grensted, 1922).

Swinton (T. R., see Woodward, 1913, pl. 19, figs. 1, 6, 17).

Cheshire : Near Birkenhead (P. R. Shaw, 1890 ; R. S., L. E. A., E. R. S.).

Bickley, near Malpas (C. O., 1894 ; olim *pusillum*).

Canal, Beeston Castle (C. O., 1920 ; var. *crassa*).

Hatchmere, Delamere Forest (C. O., 1920).

Mouldsworth (J. E. C.).

Pond, Marston, near Northwich (C. O., 1891 ; olim *pusillum*).

Marbury Mere, Northwich (B. R. L., 1917).

Pickmere Mere (C. O., 1894 ; olim *pusillum*).

Ditch, Knutsford (C. O., 1901).

Pond, Mere Heath Lane, Knutsford (C. O., 1901 ; olim *pusillum*).

Rostherne Mere, Mere Lot reed beds (W. M. T., 1914), off Harper's Bank (W. M. T., 1914), outlet brook (W. M. T., 1912), off Mason's Field (W. M. T.,

1914), Gale Bog (J. W. J., 1921), Blackburn's Brook (J. W. J., 1921).
Ditch, Mobberley (C. O., 1893).
Pond, Birken Heath, Ashley (C. O., 1893).
Hampson's Pit, Baguley (C. O., 1894; olim *pusillum*).
Pond, Baguley Moor (J. W. J., 1902).
Lymm Dam (J. G. K., 1917).
Pond, Northen Etchells (C. O., 1902; J. W. J., 1903; olim *pusillum*).
Ditch, Sale Meadows (C. O., 1892; olim *pusillum*).
Pond, Dean Row, Wilmslow (C. O., 1899; olim *pusillum*).
Mottram St. Andrews (C. O.; size $4 \times 3{\cdot}4 \times 2{\cdot}2$ mm.).
Swampy ground, Marple Park (C.O., 1895; olim *pusillum*).
Canal, Marple (J. W. J., 1915; var. *crassa*).

Pisidium pulchellum Jenyns.

Lancs. W.: Canal, Borwick, near Carnforth (C. O., 1920).
Haweswater, Silverdale (J. W. J., 1909).
Peaty ditch connecting Haweswater and Little Haweswater, Silverdale (C. O., 1920).
Knott End, near Fleetwood (R. S., as *nitidum*).
Newsham (W. H. H.).

Lancs. S.: Canal, Tarleton (W. H. H.).
Southport (L. E. A., T. R., E. R. S.).
Ainsdale (W. H. H.).

Cheshire: Near Birkenhead (P. R. Shaw, 1890; R. S.).
Pond, Marston, near Northwich (C. O., 1891).
Pickmere (C. O., 1894).
Brickfield pond, Knutsford (C. O., 1894).
Rostherne Mere, south end (W. M. T., 1914), off Harper's Bank (W. M. T., 1914), outlet brook (W. M. T., 1912), off Mason's Field (W. M. T., 1914), Gale Bog (J. W. J., 1921), Blackburn's Brook (J. W. J.).

Pisidium moitessierianum Paladilhe (= *parvulum* Johansen non Clessin = *torquatum* Stelfox).

Cheshire: Canal, Beeston Castle (C. O., 1920; one has well-marked spines: see Woodward, *Proc. Malac. Soc.*, 1921, p. 212).

NEW LAND SHELLS FROM THE MALAY PENINSULA.

By J. R. le B. Tomlin.

Plate 13.

(*Read before the Society, 17th October, 1941.*)

Previous papers on this subject will be found at pp. 73 and 146 of this volume. As before the material comes from the Raffles Museum.

Diplommatina (*Sinica*) *lenggongensis* n.sp., pl. 13, f. 1.

Shell yellowish, elongate, almost scalarescent, consisting of about nine whorls separated by an extremely deep suture ; the protoconch of two whorls is smooth, the next two have fine, close axial costulae, the remaining five have distant, wavy axial costulae at right angles to the whorl ; the last four whorls are distinctly keeled and the penultimate one is smaller than the antepenultimate. Aperture almost circular with a tubercle on the columella.

Long. 3·25 mm. ; diam. max. 1·60 mm. Hab. Lenggong, Perak.

This species is closely related to *superba* [1] Godwin-Austen and G. Nevill, but is more elongate, more bluntly keeled, and differs radically in axial sculpture : the costulae in *superba* are very close and very obliquely sloped.

Sinoennea lembingensis n.sp., pl. 13, f. 2.

A very small smooth, white shell, rather like a *Vertigo* in form, with six whorls ; the armature consists of a strong parietal tooth, a somewhat pointed swelling on the outer lip exactly opposite to the lower end of the parietal, a small tubercle within the aperture about two-thirds of the way down at the back of the labial tooth, and a bidentate hump deeply seated within on the columella ; aperture quadrate ; suture well impressed ; umbilicus narrow but deep.

Long. vix 2 mm. ; diam. max. 1 mm. Hab. Bukit Chatas, Sungei Lembing, Pahang.

Sinoennea chatasensis n.sp., pl. 13, f. 3.

A small barrel-shaped shell of about the same size as *butleri* Peile but considerably broadened in the middle and narrowed above and below. It has a smooth protoconch of two whorls, and seven whorls in all, of which the five have fairly close broadish axial riblets, about thirty-five on the antepenultimate whorl ; suture shallow ; umbilicus large and deep ; aperture quadrate with a strong parietal tooth, a conspicuous central labial tooth on

[1] *P.Z.S.*, London, 1879, p. 739, pl. 60, f. 5, 5*a*.

the columella side, a rather more acute one opposite on the outer labrum and a smaller deep-seated tubercle behind the last-mentioned tooth.

Long. 3·25 mm.; diam. max. 1·75 mm. Hab. Bukit Chatas, Sungei Lembing, Pahang, rather common.

Sinoennea tweediei n.sp., pl. 13, f. 4.

A very broad shell, flattened at the apex, not at all unlike *hungerfordiana* Mllff. with the entire aperture much more thrown forward even than in that species. There are seven whorls, two of them constituting a smooth protoconch, the other five with regular, somewhat retractive axial riblets, of which there are about thirty-two on the antepenultimate whorl; this whorl is broader and more swollen than the rest; suture shallow; umbilicus large and deep, with the last whorl keeled round it; aperture patulous, elongate with a parietal and a pointed tooth on the outer labrum all but meeting, and forming a sort of auriform pocket in the upper right-hand corner; there is a deep-set blunt tubercle at the back of the labial tooth.

Long. 3·40 mm.; diam. max. 2·50 mm. Hab. Lenggong, Perak.

This may be known from *hungerfordiana* by its broader and more flattened shape and by the greater projection of the last whorl.

Sinoennea chintamanensis n.sp., pl. 13, f. 5.

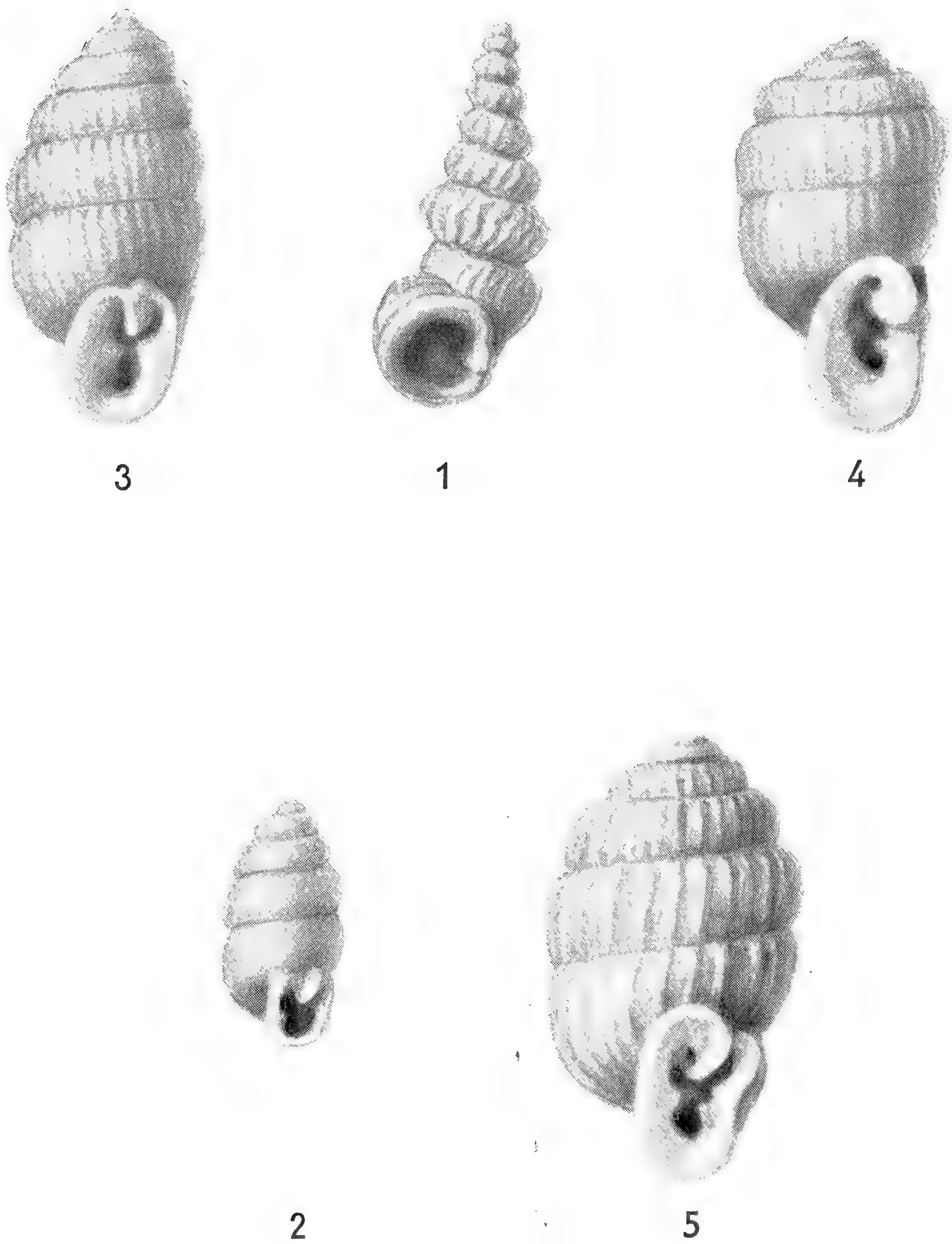
Somewhat the build of *chatasensis* herein described, but shorter in proportion to breadth, with a different aperture, and differently sculptured. This shell has seven whorls, the first two forming a smooth protoconch, and strong, distant axial riblets of which there are about twenty on the antepenultimate whorl; umbilicus deep but rather narrow; suture shallow; aperture oblong, gradually narrowing; parietal tooth large and curving to the left, a large tooth about the centre of the outer lip with a bulge on the peristome above it and a labial tooth opposite on the columellar side; there is also a strong deep-seated protuberance in the throat of the aperture; peristome much thickened and expanded.

Long. 3·40 mm.; diam. max. 2 mm. Hab. Bukit Chintamani, between Bentong and Karak, Pahang, rare.

PLATE 13.

(All × 12.)

FIG. 1.—*Diplommatina (Sinica) lenggongensis* n.sp.
FIG. 2.—*Sinoennea lembingensis* n.sp.
FIG. 3.— ,, *chatasensis* n.sp.
FIG. 4.— ,, *tweediei* n.sp.
FIG. 5.— ,, *chintamanensis* n.sp.



[*See pp*. 319, 320.

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LIST OF OFFICERS AND COUNCIL FOR 1941-42.

C. P. RICHARDS (1851–1941).

By G. N. RICHARDS and Dr. J. W. JACKSON.

CHARLES PERCY RICHARDS, of the Mission House, Stenalees, St. Austell, Cornwall, passed away on the 26th February, 1941, aged 90 years, and was buried at Treverbyn Cemetery. He was an old member of the Society, having joined on 14th March, 1900. For over 65 years he was a clergyman among the china-clay workers of Stenalees. From his youth he was an ardent student of natural history in many branches, but for the last 50 years conchology, in which he had an extensive collection, predominated over all other studies. He was a keen observer and wrote many papers on insects injurious and beneficial to mankind. A very generous and kind-hearted man, he was always ready to share his shells and minerals found in his neighbourhood. Of the latter he had many interesting specimens illustrating the formation of china-clay, and distributed examples to friends and museums.

BERNARD RICHARD LUCAS (1864–1941).

By J. WILFRID JACKSON, D.Sc., F.S.A. (Manchester Museum).

BERNARD RICHARD LUCAS, of Dale Lodge, Staindrop Road, Darlington, died on 14th June, 1941, at the age of 77, after a long illness. He was born in Paris of English parents. His father was a Chesterfield man, and was a silk merchant in Paris: his mother was a Devon woman and daughter of Dr. Turse, of South Molton.

Lucas was employed for a short time in Middlesbrough before becoming associated with the Brunner Mond Co. (now I.C.I., Ltd.), at Northwich, Cheshire. This association lasted for more than forty years. He removed to Darlington on retiring some twelve years ago.

While in Cheshire he took a great interest in the local salt deposits and carried out much research in these and similar deposits in different parts of the world. He travelled widely and visited the United States, Canada, Australia, and New Zealand among other places.

Lucas was a Life Member of the Conchological Society, which he joined in 1898. He served for many years as a Vice-President, as one of the Trustees from 1930–3, and was a frequent attender at the meetings in Manchester, especially when living in Cheshire. Though not a prolific writer he contributed several papers to the *Journal of Conchology*, including one "On the spreading of *Physa heterostropha* in Lancashire and Cheshire", and others on the

"Danger of using mercuric chloride in sterilization of highly polished shells", and "Preservation of Land Shells", as well as short notes on shells collected in Cheshire, Isle of Man, Ireland and France. One of his last papers was on the "Non-Marine Deposits in Yorkshire and Durham" written in collaboration with A. S. Kennard. His interest in such deposits began early. In 1908 he called my attention to deposits of Holocene shells near Great Mitton, West Yorkshire (see this *Journal*, vol. 12, 1909, p. 263), and on seeing a number of shells collected by me from the famous tufaceous beds at Caerwys, North Wales, he visited the locality for several years and obtained a large number of species (see *Lancs. and Chesh. Nat.*, vol. xiv, 1922, pp. 147, etc.). Exhibits made by him at the meetings of the Society included shells from Winnington and other Cheshire localities, North Devon, Yorkshire, Sligo, Madeira and Australia.

He joined the Malacological Society of London in 1905 and became a Fellow of the Geological Society of London in 1909. From 1924 to 1931 he served as a member of the Committee of the Manchester Museum. He made frequent gifts to that Institution, including calcareous seaweed from the Solomon Islands; human skulls from a cave at Rousson, Gard, and from a railway-cutting at Villers Campeau, France; various bones and teeth of cave-bear from a cave at Vallon Ardèche, South France; large slab of rock salt crystals from a mine at Northwich, Cheshire; larva of puss moth with attached parasitic ichneumon larvae; glacial shells from Northwich; Dervish charm from the Soudan; ores of zinc from mines in Wales; a cylinder containing twinned crystals of selenite (sulphate of lime) formed in a borehole in four years from Dombasle-sur-Meurthe; specimens of timbers and *Eucalyptus* pods from Australia; ripple-marked sandstone slab from Frodsham, Cheshire; and sandstone slab with footprints of *Rhynchosaurus* from near Beeston, Cheshire.

Soon after he was established at Darlington he became an active member of the local Field Club and acted as curator of the museum. The Hon. Secretary of the Club, Mr. J. E. Nowers, speaks highly of his friendship and assistance.

As seen above, in addition to conchology, Lucas was greatly interested in geology, ornithology, entomology, and botany, and made collections in most of the places he visited. When in Australia in 1921 he collected among other things *Helix aspersa* from Mount Gambier, S. Australia; several skulls of animals from places in West Australia; varieties of *Eucalyptus*; and Permo-Carboniferous fossils.

He left his large and valuable collections to the Darlington Museum and to the Darlington and Teesdale Naturalists' Field

Club. To the first-named Institution he left his remarkable collection of shells including British Land and Freshwater species. There are some 420 drawers contained in specially built cabinets and the shells are carefully classified and indexed. He also donated his fine collection of British beetles to the same Institution. To the Field Club he left his cabinet of eggs of British birds, most of which he collected himself. On one occasion he and his wife spent a month in the Orkneys devoting most of their time to collecting eggs and studying bird life. The eggs are contained in a large cabinet and the same meticulous care in their arrangement is seen here as in the shells and beetles.

Throughout his life Lucas maintained his association with France and spoke her language with the grace and ease of a native.

I am indebted to Mrs. Lucas; Mr. F. Dallimore, Borough Librarian, Public Library, Art Gallery, and Museum, Darlington; and Mr. J. E. Nowers, Hon. Secretary, Darlington and Teesdale Naturalists' Field Club, for assistance in compiling this short obituary.

Foreign Shells at Sandwich.—In June, 1935, I found a living *Petricola lithophaga* Retz., a common Mediterranean species, at Sandwich, and in August, 1926, three living *Donax laevigatus* Desh., a Californian shell. Both species were washed up at extreme low water and may have been brought over on the bottoms of ships which anchor in the Downs.

R. H. Moses.

Spawn of Æolidia papillosa (L.).—Alder & Hancock in pt. vi of their Monograph state that the spawn-ribbon of *Æolidia papillosa* "is occasionally white, but has generally a pinkish tinge, and is sometimes distinctly rose-coloured". I once (Greenisland, Co. Antrim, 4th March, 1935) took a large purplish-grey *papillosa* which was extruding a pure-white spawn-ribbon. About 18 hours later the white spawn had become pale-pink! I have found both white and rosy-pink spawn of this species at Greenisland, and regret that I did not examine it microscopically to see if the stages of development of the ova differed in the differently coloured spawn.

N. McMillan.

(*Read before the Society* 14*th November*, 1941.)

MILAX GRACILIS (LEYDIG) IN WOODLAND.

By A. E. Ellis.

(*Read before the Society, 17th October, 1941.*)

So far as I have been able to ascertain, *Milax gracilis* (Leydig) is known to be habitually if not invariably a slug of cultivation. Phillips and Watson (*J. Conchol.*, **19**, 91) state that " hitherto it has only been found in or near gardens ", while Boycott, in the Recorder's report for 1931 (*J. Conchol.*, **19**, 185), mentions that " all the *gracilis* so far have been found in gardens ". At Epsom, Surrey, it is a common slug in gardens, and I have found it also in chalk pits, at the edges of fields, around farm buildings and in an orchard, always within a few hundred yards of buildings or gardens, and generally associated with *Milax sowerbii* and *Limax flavus*, rarely with *Milax gagates*. In view of this slug's customary preference for cultivated land and the vicinity of dwellings, it came as a surprise to encounter *M. gracilis* in old woodland in Norbury Park, near Mickleham, Surrey, in as wild and natural a habitat as exists in south-east England. These picturesque woods constitute a typical calcareous beech consociation (Fagetum sylvaticae calcicolum), with many ancient yews, and also ash, sycamore, box, elder, etc., and a field layer of dog's mercury. The following Mollusca were found in the part of the woodland where *M. gracilis* occurs :

Pomatias elegans (Müller)
Acme lineata (Drap.)
Carychium tridentatum (Risso)
Azeca goodalli (Fér.)
Cochlicopa lubrica (Müller)
Pupilla muscorum (L.)
Acanthinula aculeata (Müller)
Vallonia excentrica Sterki
Ena obscura (Müller)
Clausilia rugosa (Drap.)
C. rolphii Turton
Marpessa laminata (Mont.)
Punctum pygmaeum (Drap.)
Gonyodiscus rotundatus (Müller)
Euconulus fulvus (Müller)
Vitrea crystallina (Müller)
Retinella nitidula (Drap.)
Retinella pura (Alder)
Oxychilus cellarium (Müller)
O. alliarium (Miller)
O. rogersi (B. B. Woodward)
Vitrina pellucida (Müller)
Arion ater (L.)
A. hortensis Fér.
A. circumscriptus Johnston
A. intermedius Normand
Agriolimax reticulatus (Müller)
Limax arborum B.-Chant.
L. maximus L.
Trichia hispida (L.)
T. striolata (C. Pfeiffer)
Cepaea nemoralis (L.)
C. hortensis (Müller)
Helix pomatia L.
Helix aspersa Müller.

It is not likely that this is a complete list of the Mollusca of these

woods, for I was collecting false-scorpions at the time and not paying particular attention to the snails, but it is sufficient to indicate that the fauna is characteristic of ancient, natural woodland. It is conceivable that *Milax gracilis* was introduced from the gardens of Norbury House, or perhaps with pheasant food, but apart from what is known of its usual habitats there is little to indicate that it is an interloper. Whether native or denizen, *M. gracilis* is established now in Norbury woods, where it may be seen sharing the same log as *Acme lineata* and *Clausilia rolphii*, true children of the wild.

Testacella scutulum Sowerby, which was found under fallen branches and beneath loose bark in another part of the woods in Norbury Park, is almost certainly an "escape" from gardens of houses in Crabtree Lane, West Humble, at the border of the woodland. To find *T. scutulum*, *Azeca goodalli* and *Clausilia rolphii* within a few inches of one another under the same log is an unusual experience. It is possible that species of *Testacella* are more frequent in wild places than is supposed, as their subterranean and nocturnal habits conceal them from the eye of the collector. There is certainly no scarcity of earthworms, the staple food of these slugs, in the humus of woodland.

Red Littorina saxatilis.—Some years ago R. J. Welch gave me a series of *Littorina saxatilis* (Olivi) which he had collected at Mullaghderg, West Donegal. The shells ranged in colour from a beautiful vivid orange-red, almost vermilion in intensity, to blood-red. Collecting on the shores of N. E. Ireland from Carlingford Lough to Malin Head has only yielded me an occasional odd specimen of this showy colour-var., but in 1938 at Whitestrand Bay, on the west side of Malin Head I came upon the variety in vast numbers. It predominated, and apparently made up at least 70-80 per cent of the total *L. saxatilis* population.

This pretty colour-var., seems to be scarce ; it certainly does not occur either in the Mersey or Dee, or in Anglesey where I have collected fairly widely, and Dr. Helen Blackler tells me it is not present in the Port Erin district.

The Whitestrand Bay examples seem referable to *Littorina saxatilis rudis* Maton var. ex col. *miniata* Dautz. & H. Fisch. (*Camp. Arct. Prince de Monaco*, p. 199, 1912) and var. ex col. *sanguinea* Dautz. & Durouchoux (*Faunule Malacologique des environs de Saint-Malo*, *Feuille des Jeunes Naturalistes*, 1900, p. 8).

N. McMillan.

(*Read before the Society* 14*th November*, 1941.)

NOTE ON *LYMNAEA PALUSTRIS*, MÜLL.

By WALTER E. COLLINGE, D.SC.

IN the summer of 1926 the late Mr. W. H. St. Quintin brought to me for identification a number of living specimens of the pond snail *Lymnaea palustris*, Müll., and I placed these in a large glass vase containing about 1½ gallons of water, with a number of weeds. From 1927 to 1933 each spring large numbers of the egg masses were observed attached to the inside of the glass. In 1934 I noticed that the number of egg-masses was considerably less than previously and the rate of growth slower. In 1935 and 1936 only four and three egg-masses were observed and the 1936 specimens were only slightly over half the normal size. In 1937 only a single small egg-mass was observed and very few of the ova developed; the few specimens that were born only lived the year out.

Although a very close and careful watch was kept during 1938 no egg-masses were observed and it was perfectly certain that in the spring of 1939 not a single specimen remained.

It would seem as the result of interbreeding over a period of thirteen years that the function of reproduction had gradually degenerated and died out.

A further interesting fact observed was that each spring, prior to egg-laying, large numbers of the specimens crawled out of the glass vase, but at no other time did they leave the water for other than very short periods.

Food of Nudibranchs.—Two *Palio nothus* (Johnston) were offered a mixed lot of *Cladophora* spp., *Corallina* sp., and various Hydroids. They ignored all except the Polyzoon *Bowerbankia imbricata* (Adams) which they ate greedily.

Goniodoris nodosa (Mont.) was found close to the Tunicate *Diplosoma listerianum* and in captivity ate it.

Archidoris flammea (A. & H.) refused the yellow sponge *Halichondria fibrosa* (Fristedt) and ate the scarlet *Hymeniacidon sanguinea*.

Idulia coronata (Gm.) found among *Sertularia pumila* (L.) and *Campanularia flexuosa* Hincks. In captivity crawled at once off *S. pumila* and on to *C. flexuosa* which it seemed to eat.

Facelina drummondi (A. & H.) ate *Clava squamata* (O. F. Müller).

Æolidia papillosa (L.).—I have several times found this species devouring large examples of the anemone *Tealia crassicornis*. Eliot says this is unusual.

Tergipes despectus (Johnston) from Hilbre, Cheshire, was taken upon the Hydroid *Obelia dichotoma* (L.) and ate it freely in captivity.

These notes, save the last, were made at Greenisland, Co. Antrim. I am indebted to Dr. M. Burton, Dr. A. B. Hastings, and Captain Totten for the identification of some of the animals mentioned.

N. MCMILLAN.

(Read before the Society, 14th November, 1941.)

NEW OR LITTLE KNOWN MOLLUSCA FROM CENTRAL AFRICA.

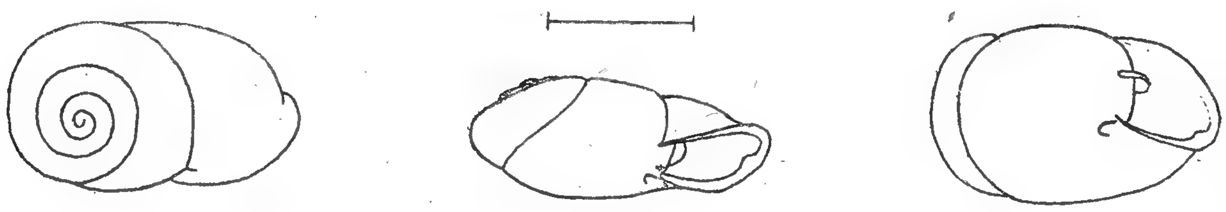
By M. Connolly.

(*Read before the Society, 14th November, 1941.*)

Family STREPTAXIDAE

Gonaxis pseudotmesis sp.n. (Text-figs. 1–3).

Shell of fair size, elongate oval, rimate, much flattened, thin, transparent, pale olivaceous. Spire distorted, first three whorls hidden in frontal aspect, summit flat. Whorls five, little convex, rapidly increasing, first two smooth and glossy, remainder sculptured above with very close, fine, regular, oblique costulae, very smooth and glossy beneath and on front of shell; suture simple. Aperture inverted mitriform, peristome white, glossy, very narrowly reflexed, dentition two-fold: a strong, narrow, superficial plait on centre of paries and a small tubercle on the edge of the peristome on left of base, which imparts to the columella a false appearance of truncation.



1 2 3

Gonaxis pseudotmesis. ×2. L=9·6, D=5·9, d=h=4·1.

Alt. 9·6, lat. 5·9; apert. alt. 3·5, lat. 3·0; last whorl 9·0 mm.
Hab. Gold Coast. Aburi (G. S. Cotterell).
Type in British Museum.

The sub-basal tubercle, causing the columella to have an Achatinoid appearance, distinguishes this species from others so far described.

Genus *Lamelliger* Ancey, 1884.

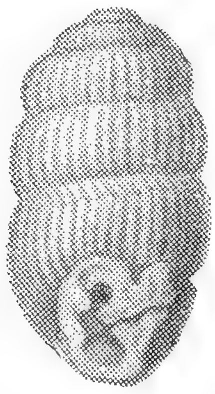
Lamelliger maassi Dgnr.

1928 *Gonaxis troberti* Petit (*pars*), *Conn.*, *A.M.N.H.*, i, p. 531.
1934 *Lamelliger maassi* Dgnr., *Zool. Jahrb.*, lxv, p. 224.

It may obviate future confusion if I recall that when chronicling the land shells of Sierra Leone I mentioned four local races of *G. troberti* of which the shells appear to differ in nothing except size, ranging from about 6 up to 10 mm. in length. Study of the anatomy of animals from farther south has decided Degner to separate the largest of these races from the smaller as a distinct species, which he states is common in French Guinea and ranges from 10·1 to 12 mm., the type being 11·3 mm. long. On anatomical grounds he has also raised to full specific rank the subgenus *Lamelliger* which Ancey proposed in 1884 for *G. leonensis* (Pfr.) (= *troberti* Petit).

Gulella sandersoni sp.n. (Text-fig. 4).

Shell very small, rimate, short cylindriform, fairly solid, asperate, milky olivaceous. Sides of spire regular, summit bluntly rounded. Whorls 6, fairly convex, gradually increasing, first 2 smooth, 3rd nearly so, last 3 sculptured with strong, regular, vertical costulae; suture simple, rather deep. Aperture quadrate, peristome white, glossy, thickened and slightly reflexed, dentition 5-fold: a strong, somewhat triangular angular lamella, with lower edge close and parallel to a strong triangular labral plait; a low, much immersed basal plate; a long, low, bluntly pointed swelling occupying most of the columellar lip and a small denticle, pointing obliquely to the centre, in the angle of columella and paries.

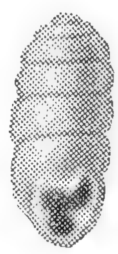


4. *Gulella sandersoni.* × 10.

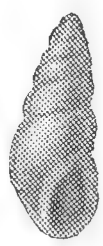
Alt. 2·4, lat. 1·25; last whorl 1·25 mm.
Hab. S. Nigeria. Nko, Opubre District, under leaf mould (Ivan T. Sanderson).
Type in British Museum.

Gulella labiotuberculata sp.n. (Text-fig. 5).

Shell of moderate size, rimate, cylindrical, smooth, glossy, pale olivaceous. Sides of spire straight and regular, apex (3 whorls), a low cone. Whorls $7\frac{1}{2}$, last 4 nearly flat, almost equal in length and breadth, practically devoid of sculpture; suture shallow, simple. Aperture quadrate, rounded at base, dentition 4-fold: a strong curved angular lamella; a small sharp denticle near the surface half way down the labrum, corresponding to a deep external punctation; a well-defined tubercle on the surface of and half-way up the columellar lip and a hardly noticeable flat low process deepset within the upper columellar angle.



5. *Gulella labiotuberculata.* × 2.



11. *Opeas elgonense.* × 2.

Alt. 7·0; lat. 3·0; apert. alt. 1·5, lat. 1·4; last whorl 3·6 mm.
Hab. Tanganyika Territory (in coll. W. Blume).

Gulella titania adansiensis subsp.n.

Similar to the type (*A.M.N.H.*, i, p. 531, pl. xviii, f. 4, 1928) in form, but about twice its size, and the costae on the last whorl, which become wide apart in the type, remain close together. The apertural dentition is the same, except that in the Ashanti race the basal tooth is a square slab, more centrally situate than in the type.

Alt. 4·2, lat. 2·3; apert. alt. 1·2, lat. 1·0; last whorl 2·4 mm.

Hab. Ashanti. Adansi (R. A. Freeman).

Type in British Museum.

The new subspecies differs from *G. opoboensis* (Preston), which is of the same size and contour, in the same particulars as are mentioned in my description of G. *titania*.

An immature shell of 5 whorls bears on the centre of the paries a strong deeply entering lamella, similar to that found in *L. maassi* Dgnr. and *troberti* Petit, but lacks the remaining dentition which characterizes their young stage.

Conogulella conospira (Mts.).

1896 *Ennea* (*Gulella*) *conospira* Mts., forma *minor* Ailly, *Bihang k. Sv. Vet.-Akad. Handl.* xxii, iv, 2, p. 19, pl. i, f. 6–9.

Ailly's figure correctly portrays the apical sculpture; the first whorl is heavily malleate, apparently without spirals, but the next 1½ bear 4 strong coarse distant spiral threads, which then end abruptly and are replaced by strong transverse costulation.

Family HELICARIONIDAE

Sub-Family TROCHONANININAE.

(= LEDOULXIINAE Pilsb.).

Genus *Trochonanina Mouss.*, 1869.

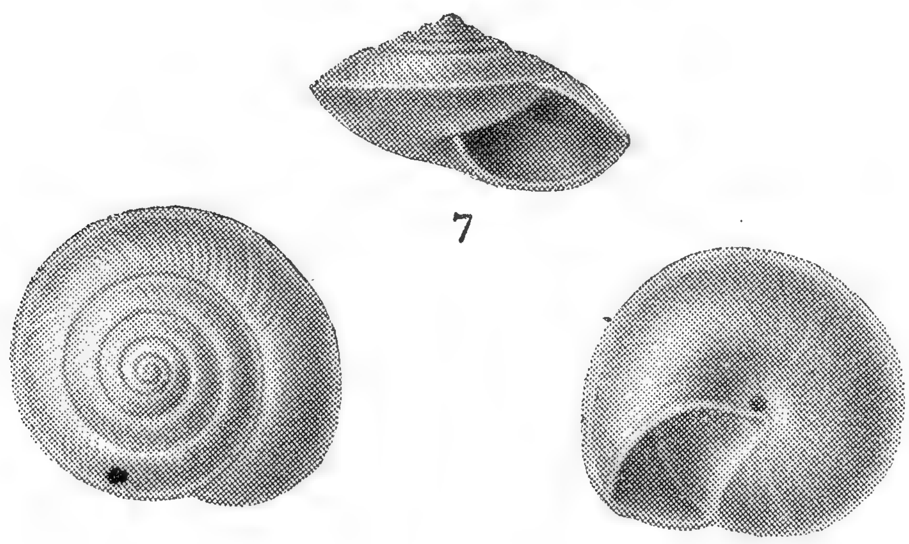
(Type *Helix mozambicensis* Pfr.).

Dr. Burrington Baker has pointed out that, irrespective of the possible invalidity of Kobelt's *Ill. Conchylien-buch* for the determination of Types, an earlier date for that of *Trochonanina* is Nevill's in the *Handlist Moll. Indian Museum*, i, 1878, p. 45, which appears conclusive in so far that *Trochonanina* must be restored to the African fauna at the expense of *Ledoulxia* Bgt., which falls into its synonymy.

Trochonanina pitmani sp.n. (Text-figs. 6–8).

Shell comparatively large, perforate, depressed conoid, thin, dull and asperate above, smooth and glossy beneath, subtransparent,

corneous brown above, pale buff beneath. Spire little exserted, sides very slightly convex. Whorls 6½, not very convex, regularly increasing, carinate at periphery, extreme apex smooth, next two whorls bearing fine, close, microscopic transverse striolae cut by equally close microscopic spiral lines, remainder sculptured with close, fine, curved, oblique transverse striae, gradually increasing in strength and distance apart; basal sculpture consisting of faint transverse growth lines cut by close, regular, wavy spiral grooves. Aperture horizontal, subquadrate, peristome simple, acute, columella very weak, margin barely reflexed, not obscuring the narrow umbilicus.



7

6 8

Trochonanina pitmani. × 1.

Diam. maj. 22·0, min. 19·0, Alt. 10·0; apert. alt. 6·0, lat. 10·0 mm.

Hab. S.W. Uganda (Capt. C. R. S. Pitman).

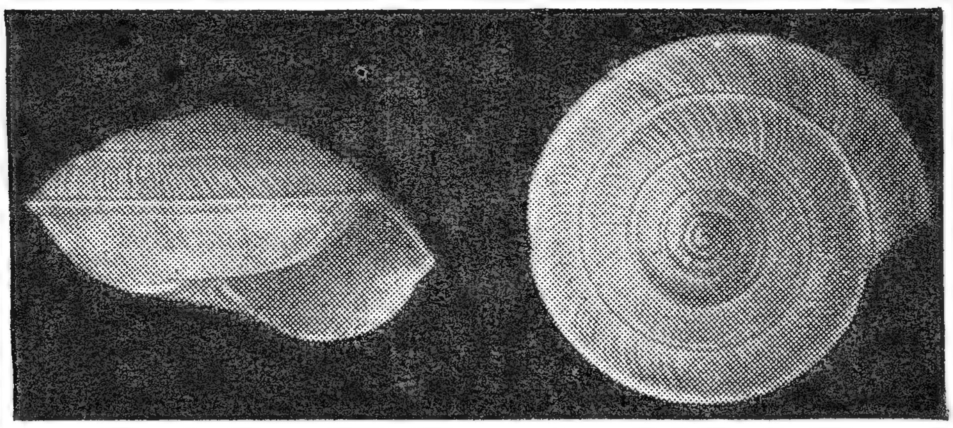
Type in British Museum.

One of the largest and flattest of the unicoloured group of this genus. *T. filomarginata* (Kob.), which resembles it in general shape and flatness, differs entirely in its markings, being strongly mottled with white flecks and stripes on a brown ground, and has also rather wider perforation.

Trochonanina liberiae (A. D. Brown). (Text-figs. 9, 10.)

1865 *Helix liberiae* Brown, *Amer. J. Conch.*, i, p. 136.

By the courtesy of Dr. Pilsbry I am enabled to present a photograph of this unfigured species, which was described, among other points, as being perforate, thin, diaphanous, pale corneous, with 7 flattish whorls and simple peristome, umbilical margin reflexed.



9 10

Trochonanina liberiae (A. D. Brown). × $2\frac{9}{10}$ths.

The shell figured measures 10·0 by 17·8 mm. in height and major diameter.

Hab. C. Palmas.

Family HELICIDAE.

Larogiella malasanjiensis Preston.

1914 *Larogiella malasanjiensis* Prest., *P.Z.S.*, p. 801, pl. i, f. 23.
1914 *Urguessella cuticularis* Prest., *P.Z.S.*, p. 804, pl. i, f. 27.

Pilsbry pointed out in 1919 that the seven so-called genera *Elgonella*, *Burungaella*, *Blayneyella*, *Larogiella*, *Nakuruella*, *Mikenoella*, and *Urguessella*, which were created by Preston in 1914 and placed by him in the Zonitidae, are probably Helicoid rather than Zonitoid, but until their anatomy is known it is uncertain whether they will become merged in *Halolimnohelix* Germain, or perhaps take precedence of one or other of the genera propounded by Pilsbry himself in 1919.

Both the species cited above hailed from Malasanji, Uganda, *cuticularis* being an immature example of *malasangiensis*, the latter of which has lost most of the hairs which are prominent on the former, but still retains a few on the earlier whorls.

Family ACHATINIDAE.

Pseudotrochus janssensi Dup. & Putz.

1922 *Pseudotrochus janssensi* D. & P., *Ann. Soc. Zool. Belg.*, liii, pp. 42, 45, text-fig. 2. mut. ex colore *efasciata* n.

What appears to be the typical banded form of this species was distributed by Preston about 1913 bearing a manuscript Latin name signifying "bifasciate". The efasciate variety, collected in company with the former, agrees therewith in every respect,

except that the spiral colour bands are entirely lacking, though the columellar region is just as darkly coloured as in the normal form.

Hab. Camerun. Bitze (Bates).

Type in British Museum.

Bocageia carpenteri Conn.

1931 *Bocageia carpenteri* Conn., *A.M.N.H.*, viii, p. 319, pl. xii, f. 5.
1933 *Bocageia* (*Liobocageia*) *bukaensis* Thiele, *Sitz.-Ber. Ges. nat. Fr.*, p. 307, pl. ii, f. 43.

Thiele's species, described from the Buka Mts., S. Abyssinia, is entirely identical with *carpenteri* and must fall into its synonymy, thus affording yet another instance of the occurrence of Abyssinian species on the Central African mountains, without any known intermediate locality.

Opeas elgonense sp.n. (Text-fig. 11).

Shell small elongate turriform subrimate, smooth, rather glossy, transparent, pale olivaceous. Whorls $6\frac{1}{4}$, fairly convex, regularly increasing, first two practically smooth, remainder sculptured with extremely fine, faint, slightly curved, nearly vertical striolae; suture simple, well defined. Aperture acuminate ovate, peristome simple, acute, labrum very slightly curved backward in profile, columella erect, nearly straight, margin most narrowly reflexed, scarcely forming a rima.

Long. 7·1, lat. 2·8; apert. alt. 2·6, lat. 1·2; last whorl 3·4 mm.

Hab. Uganda. Mt. Elgon (C. W. C. Foster).

Type in British Museum.

It would seem almost impossible that this very ordinary little shell, which was collected in large numbers, should have escaped notice hitherto, but I can find nothing comparable to it in this part of the continent, while it differs from all the more southerly members of its genus.

Family ELLOBIIDAE.

Melampus obovatus H. & A. Adams.

1854 *Melampus obovatus* Ads., *P.Z.S.*, p. 12, No. 32.
1854 *Melampus liberianus* Ads., *P.Z.S.* p. 12, No. 37.

The type set of *obovatus* simply consists of half-grown examples of the type set of *liberianus*, and it is inconceivable how any responsible conchologist could have been induced to describe the two forms as distinct species. Dohrn has already drawn attention to the synonymy, which I can unhesitatingly confirm; unfortunately *obovatus* has priority over the better known name.

Family THIARIDAE.

Potadoma dykei Spence.

1931 *Goodrichia dykei* Spence, Conn., *A.M.N.H.*, viii, p. 320, f. 6.

This species is, of course, a typical *Potadoma* and my misapplication of the generic name in the above reference was due to mental aberration !

PELECYPODA.

The following notes on some almost forgotten species in the National collection may be of use to future investigators.

Aspatharia subreniformis (Sow.).

1867 *Anodon subreniformis* Sow., *Conch. Icon.*, pl. xiv, No. 50.

The type measures 61 by 30 by 16·5 mm. The ventral margin is markedly incurved. The shell agrees with *A. dahomeyensis* (Lea) in every detail except that the umbones are situate in one-third of the length, whereas in three measured specimens of *dahomeyensis* they occur in $\frac{1}{3\cdot8}$, $\frac{1}{3\cdot8}$ and $\frac{1}{3\cdot5}$ respectively.

Hab. Lake Nyasa (Dr. Kirk).

Mutela sarae Preston (*Rev. Zool. Afr.*, iii, 1913, p. 61) resembles this species closely in its figure and may be identical.

Aspatharia tabula (Sow.).

1867 *Anodon tabula* Sow., *Conch. Icon.*, pl. xviii, No. 68.

Two of the type set measure :—

Long. 96·0, alt. 47·0, crass. 24·0 ; umbones from ant. margin 31·5 mm.

Long 80·5, alt. 37·5, crass. 19·5 ; umbones from ant. margin 28·0 mm.

A very un-obese form with almost straight dorsal margin and umbones unusually remote from anterior end ; nacre pale salmon and scars weak. It bears no resemblance whatever to *hartmanni* Mts., to which Simpson united it in 1914, while it differs from *A. pfeifferiana* (Bernardi), among other points, in greater altitude and less thickness, and the umbones being situate much farther to the rear.

Two shells of *pfeifferiana* measure :—

Long. 90·0, alt. 42·0, crass. 22·0 ; umbones from ant. margin 26·0 mm.

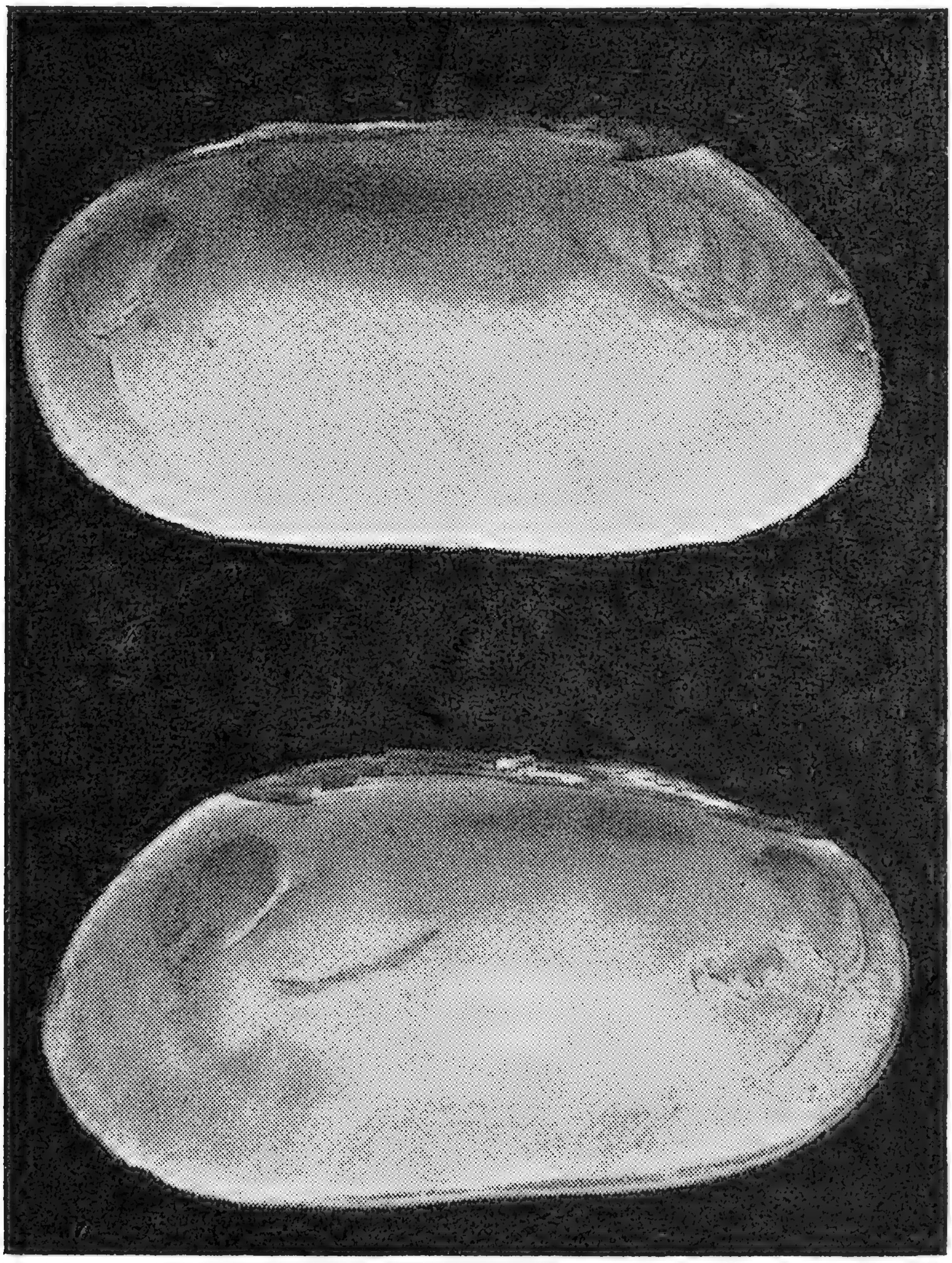
Long. 85·0, alt. 41·0, crass. 21·5 ; umbones from ant. margin 22·0 mm.

Aspatharia clappertoni (Konig) (Text-figs. 12–13).

1826 *Anodon clappertoni* Konig, Denham & Clapperton's *Travels in Africa*, App. xxiii by C. Konig, p. 255.

I append a photograph in natural size of one of the original lot of this almost unknown species. Simpson (*Descr. Cat. Naiades*,

12



13

Aspatharia clappertoni (Konig). × 1.

p. 1315, 1914) places it in the synonymy of *Spatha rubens* (Lam.), but it appears to be possibly more nearly akin to *Aspatharia* s.s. It was described from R. Gambarou (= Yeou), W. of Bornou, Sudan. The Gamaru District is about 6° 50″ N. and 35° 30″ S.

PROCEEDINGS OF THE CONCHOLOGICAL SOCIETY OF GREAT BRITAIN & IRELAND.

665th Meeting, held at the British Museum (Natural History), 17th October, 1941.

The President (Mr. A. E. Ellis), in the chair.

Present: Mr. H. C. Fulton, Dr. A. T. Hopwood, Mr. A. S. Kennard, Lt.-Col. A. J. Peile, Mr. A. E. Salisbury, Mr. R. Winckworth, Dr. L. R. Cox (visitor).

Member Elected.

Robert Ernest Palmer, 5 St. Thomas's Square, Salisbury (proposed by the Hon. Secretary, seconded by the President).

Member Deceased.

B. R. Lucas, 14th June, 1941: a life member (elected 1898) and vice-president of the Society.

The Journal of Conchology.

At the instance of the Editor, the President urged members to contribute more papers to the *Journal*. In spite of the difficulties of the times it is important that the *Journal*, which is the principal means of holding the Society together, should not be allowed to languish, and those who are in a position to contribute papers or notes are earnestly requested to do so.

Papers Read.

"Further new species from Malaya," by J. R. le B. Tomlin.
"*Milax gracilis* (Leydig) in woodland," by A. E. Ellis.

666th Meeting (Annual Meeting), held at the British Museum (Natural History), 14th November, 1941.

The President, Mr. A. E. Ellis, in the chair.

Present: Members—Mr. H. C. Fulton, Dr. A. T. Hopwood, Mr. A. S. Kennard, Lt.-Col. A. J. Peile, Dr. H. E. Quick, Mr. A. E. Salisbury, Mr. R. Winckworth.

Visitors.—Dr. L. R. Cox, Mr. N. D. Quick.

Annual Reports.

The annual report of the Council, the reports of the Yorkshire and North Staffordshire branches, and the reports of the Recorders were presented and adopted. The Hon. Treasurer made a report on the financial position of the Society, and drew attention to the fact that a number of Members had allowed their subscriptions to fall into arrears.

Appointment of Auditors.

Mr. C. H. Moore and Mr. A. K. Lawson were reappointed auditors.

Election of Officers and Council.

President: H. E. Quick, M.B., B.Sc.

Member of Council: A. Blok, B.Sc., A.M.I.E.E.

The remaining officers and members of Council were re-elected (see *J.C.*, xxi, 1941, p. 257).

Vote of Thanks.

A vote of thanks to the Auditors was cordially approved.

Papers Read.

" New or little known Mollusca from Central Africa," by Major M. Connolly.

" Notes on *Littorina saxatilis* var. *compressa* Jeff.," by J. R. le B. Tomlin and Mrs. N. F. McMillan.

" Spawn of *Aeolidia papillosa* (L.)," by Mrs. McMillan.

" Food of some Nudibranchs," by Mrs. McMillan.

" Predominance of red *Littorina saxatilis* (Olivi)," by Mrs. McMillan.

The newly elected President then took the chair.

ANNUAL REPORT, 1940–1.

THIS is the Sixty-fifth Annual Report of the Society.

During the past year reports of four deaths (James Simpson, J. G. Dalgliesh, C. P. Richards and B. R. Lucas) and of one resignation (Boston Society of Natural History) have been received. One new member has been elected.

It has again not been possible to hold the usual monthly meetings at the Manchester Museum, but occasional meetings have been held in London.

Since the Emergency Annual Meeting in London, on the 8th (not 15th) February, 1941, one number of the *Journal of Conchology* has been issued, viz. vol. 21, no. 9, 31st July, 1941, comprising 32 pages of text. This includes the " List of British Non-Marine Mollusca ", by A. S. Kennard.

Some fourteen notes and papers have been received, some of which have already appeared in the *Journal*. Others will appear in the number of the *Journal* now in the press.

The Council is pleased to note that Mr. B. Bryan, the Hon. Secretary of the North Staffordshire Branch of the Society, was elected President of the North Staffordshire Field Club on the 29th March last. He is also Chairman of the Zoology Section of the Club.

Additions to the Library have been received from Professor G. D. Hale Carpenter and Mr. H. H. Bloomer.

Donations to the Cabinet have been made by Professor G. D. Hale Carpenter (see Editorial Notes, vol. 21, p. 282).

RECORDER'S REPORT (NON-MARINE MOLLUSCA).

SINCE last report few specimens have been submitted for verification but the nine new records are all interesting additions to our knowledge. Among the additions to the list for Clyde Isles, *Planorbis carinatus* and *Bithynia tentaculata* should be regarded as doubtfully native since the specimens came from artificial fish-ponds on Bute.

Members will have noticed in Mr. Kennard's List (*Journ. Conch.*, xxi, 260–274) that we have two species of *Carychium*. In order that the Census may be brought up to date it is proposed to revise all records for this genus. Members who have specimens for verification should submit them to A. R. Waterston, Royal Scottish Museum, Edinburgh, 1.

Yorks, N. E. (62). *Viviparus fasciatus* (R. Foss, York, in coll. J. Dixon per W. Thurgood).

Renfrew (76). *Planorbis carinatus*, *P. planorbis*, *P. laevis*, *Potamopyrgus jenkinsi* (M. H. W. Miller).

Clyde Isles (100). *Planorbis carinatus*, *P. laevis*, *Bithynia tentaculata*, *Sphaerium corneum* (M. H. W. M.).

MARINE RECORDER'S REPORT.

MR. D. K. KEVAN has sent a list of 128 species and varieties from the Firth of Forth, collected above low water mark, including *Zirfaea crispata* (L.) (had been previously recorded dead by Simpson), *Cochlodesma praetenue* (Montagu) dead, *Mysella bidentata* Montagu (new to East Coast), *Alderia modesta* (Loven), *Limapontia depressa* (A. & H.) v. *pellucida* Kevan, *Berthella plumula* (Montagu), and *Onchidoris muricata* (Müller).

Mr. Lloyd James has sent in a list from Bangor College for regions IX*b* and X. This includes 138 species of which 15 do not seem to have been recorded. They include *Cuthona peachii* (A. & H.), *Embletonia pulchra* (A. & H.), *Balcis alba* (da Costa), *Phacoides borealis* (Linné), *Thracia distorta* (Montagu), and *Xylophaga dorsalis* Turton.

YORKSHIRE CONCHOLOGICAL SOCIETY.

45th ANNUAL REPORT, 1941.

As last year our activities were curtailed by war conditions, difficulty of transport being responsible for the cancelling of one outdoor excursion. Despite these conditions interest in the work of the Society has been maintained.

Papers were read by Mr. J. C. North, A Yorkshire Conchologist in the Persian Gulf; Mrs. E. M. Morehouse, Some notes about the Land Shells of the Universe; Mr. J. H. Lumb, *Helix aspersa* Müller—illustrated; Mr. W. Thurgood, Mandibles—illustrated; Mr. J. R. Dibb, Distribution; Mr. C. F. Sweetman, Radulae of Mollusca.

Mrs. Thurgood's Presidential Address had for its subject "My introduction to Conchology".

Excursions were held to Addingham and Reynard Ings, Collingham to Wetherby, Wentbridge. Ten, fourteen, and fifteen species respectively were recorded.

The Forty-fifth Annual Meeting was held on the 4th October, when the following officers for 1942 were elected:—

President, J. H. Lumb; Hon. Treasurer, J. Digby Firth; Hon. Recorder, W. Thurgood.

The remaining officers, as in 1941, were re-elected.

A provisional programme for 1942 was arranged, consisting of four excursions, five papers, and the Presidential Address.

W. THURGOOD, *Hon. Secretary.*

REPORT OF THE NORTH STAFFORDSHIRE BRANCH, 1940–1.

MR. W. HILL, of Leek, has sent the following notes: "My best record is a tumid *C. laminata*. I do not find any vars. of *laminata* mentioned in any of my books except *pellucida* and *albina*, although there is a var. *tumidula* of *rugosa*. My shell measures 15 mm. by 4 mm. Several *V. pygmaea* were found in Ladyside."

Mr. H. Emmett reports *H. caperata*, var. *obliterata*, near Leek; this, he remarks, is quoted in textbooks as scarce; it certainly is in this district. On 16th October, 1941, while searching in a garden at Newcastle, Staffs., I took one example of *Milax gracilis*, in association with *M. sowerbyi*, *A. agrestis*, *A. hortensis*, *H. cellaria*, and *G. rotundatus*. This makes my second locality record of *M. gracilis* for the county.

B. BRYAN, *Hon. Secretary.*

ACCOUNTS FOR THE YEAR ENDING 31st DECEMBER, 1941.

Income and Expenditure Account.

Dr.

	£	s.	d.	£	s.	d.
To Annual Subscriptions—						
For 1941—						
65 at 10*s*.	32	10	0			
6 at 5*s*.	1	10	0			
Arrears	7	10	0			
				41	10	0
„ Sale of Publications				13	8	1
„ Advertisements					13	6
„ Transfer from Life Membership Fund				15	2	6
				£70	14	1

Cr.

	£	s.	d.	£	s.	d.	£	s.	d.
By publication and distribution of *Journal*—									
Vol. XXI, Part 8	25	5	9						
Authors' Reprints	3	11	10						
				28	17	7			
Vol. XXI, Part 9	26	13	2						
Authors' Reprints	4	3	10						
				30	17	0			
							59	14	7
„ Printing and Stationery							2	9	3
„ Fire Insurance								10	0
„ Warehousing Stock							1	10	0
„ Carriage (Hale Carpenter gift)								6	7
„ Subscriptions—									
Malacological Society				1	1	0			
Lancs. and Chesh. Fauna Com.					5	0			
Zoological Society					5	0			
							1	11	0
„ Officers' Expenses							2	13	8
„ Balance, being excess of Income over Expenditure							1	19	0
							£70	14	1

Life Membership Fund.

	£	s.	d.
To Amount of Fund, 1st January, 1941	355	4	0
„ Dividend and Interest	15	2	6
	£370	6	6

	£	s.	d.
By Transfer to Income and Expenditure Account	15	2	6
„ Amount of Fund, 31st December, 1941	355	4	0
	£370	6	6

Research Fund.

	£	s.	d.		£	s.	d.
To Amount of Fund, 1st January, 1941	300	3	5	By Amount of Fund, 31st December, 1941. Cap.	200	0	0
,, Dividend and Interest	12	18	0	,, Balance on Transfer and Accumulated Interest	113	1	5
	£313	1	5		£313	1	5

BALANCE SHEET.

Liabilities.	£	s.	d.	£	s.	d.	Assets.	£	s.	d.	£	s.	d.
Annual Subscriptions paid in advance				4	0	0	*Investments.*						
Life Membership Fund				355	4	0	4% Funding Loan, £408 4*s.* 11*d.*, cost				350	0	0
Research Fund				313	1	5	3% Defence Bonds				200	0	0
Balance of Income and Expenditure Account—							3½% War Loan, £40 11*s.* 8*d.*, cost				40	0	0
As on 1st January, 1941	150	3	8				Cash at Bankers—Nat. Prov. Bk.	42	5	2			
For 1941	1	19	0				P.O.S.B.	192	2	11			
				152	2	8					234	8	1
				£824	8	1					£824	8	1

NOTE.—Assets in addition to those set out in the Balance Sheet are (*a*) Library, (*b*) Cabinets and Collections, (*c*) Stock of unsold publications, (*d*) Annual Subscriptions in arrear, but against this last must be set as a liability the cost of Vol. XXI, Part 10, which has been issued and for which the account (amounting to £38 17*s.* 11*d.*) was not received in time for the above accounts.

Audited and found correct.
C. H. MOORE.
A. K. LAWSON.
12th February, 1942.

ALBERT E. SALISBURY,
Hon. Treasurer,
31st December, 1941.

INDEX

ERRATA

p. 29, last line but one, for '*fartanus*' read '*fontanus*'.

p. 86, for 'centenary' read '150th'.

p. 147, for '*Sinoennex*' read '*Sinoennea*'.

p. 147, for '*Ston*' read '*Stoa*'.

p. 171, for (Salthill) 'co. Galway' read 'co. Dublin' (twice).

p. 283, fourth line, for '15th' read '8th'.